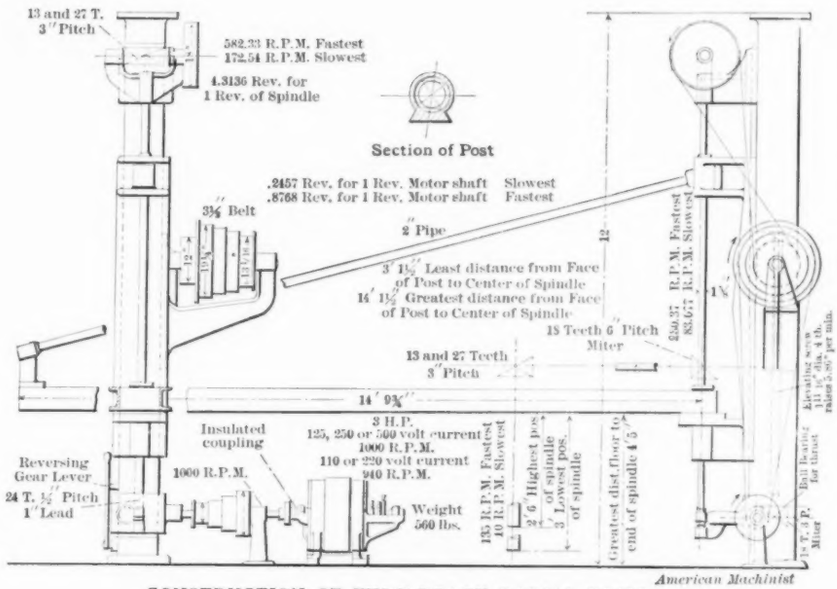
AMERICAN MACHINIST

A PRACTICAL JOURNAL OF MACHINE CONSTRUCTION.

▲ ▲ ▲

VOLUME 21. NEW YORK, THURSDAY, MARCH 24, 1898. NUMBER 12.

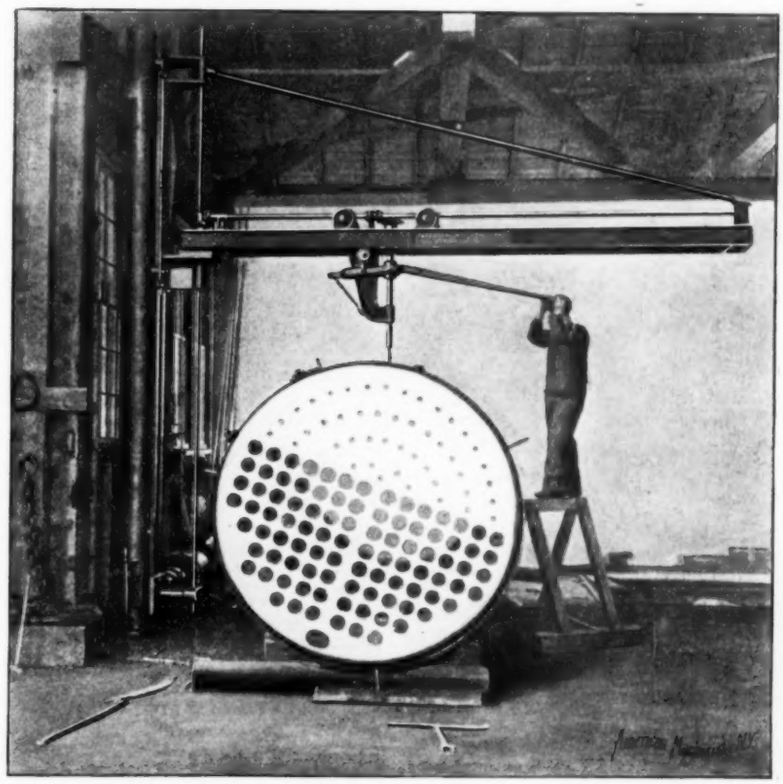
▲ ▲ ▲


13 and 27 T.
3″ Pitch
582.33 R.P.M. Fastest
172.54 R.P.M. Slowest
4.3136 Rev. for
1 Rev. of Spindle
Section of Post
.2457 Rev. for 1 Rev. Motor shaft Slowest
.8768 Rev. for 1 Rev. Motor shaft Fastest
3¼″ Belt
2″ Pipe
3′ 1½″ Least distance from Face of Post to Center of Spindle
14′ 1½″ Greatest distance from Face of Post to Center of Spindle
18 Teeth 6″ Pitch Miter
13 and 27 Teeth 3″ Pitch
14′ 9¾″
3 H.P.
125, 250 or 500 volt current
1000 R.P.M.
110 or 220 volt current
940 R.P.M.
Insulated coupling
1000 R.P.M.
Reversing Gear Lever
24 T. ½″ Pitch 1″ Lead
Weight 560 lbs.
132 R.P.M. Fastest
10 R.P.M. Slowest
Highest pos. of spindle
Lowest pos. of spindle
Greatest dist. floor to end of spindle 4′ 5″
250.37 R.P.M. Fastest
83.677 R.P.M. Slowest
12
1½″
18 T. ½″ P. Bull Beveled for thrust Miter
American Machinist

CONSTRUCTION OF WIDE REACH RADIAL DRILL.

Radial Drill for Boiler Work.

The half-tone and accompanying drawing show a new radial drill which has been specially designed for boiler and bridge shops, and is adapted for any similar work where it is desirable to command a large floor area. The drill shown is driven by a 3 horse-power electric motor on a 110 volt circuit and running at 1,000 revolutions per minute; but it may, of course, be driven from a line shaft. The column is made of any desired hight, and the arm is raised and lowered by power, so that the work may always rest upon the floor. The feed of the drill, which has a vertical travel of 6 inches, is by the long lever as shown. The arm swings easily and the trolley for the drill drive is also pushed in and out with little effort. All these movements of the drill may be effected by pulling, pushing or prying sidewise on the long feed lever. The head has a traverse of 11 feet on the arm, and the drill spindle will cover more than half of a circular area with radii of 3 feet 1½ inches and 14 feet 1½ inches. The drill spindle is 2⅜ inches diameter and has a vertical movement of 6 inches, with three speeds of revolution. The drill is made by the Fitchburg Machine Works, Fitchburg, Mass.



ELECTRICAL DRIVE RADIAL DRILL IN THE BOILER SHOP.

The Warren Bevel Gear Generating Machine.

Great activity prevails in this country at the present time in the field of improved gear-cutting machinery. We recently described the latest addition to this class of machines, adapted exclusively to the cutting of spur gears, and we now present to our readers a not less remarkable machine for making bevel gears. The chainless bicycle has, of course, furnished a powerful impetus in this direction, although it should be added that the demand made by that bicycle found the present machine fully developed, ready for it. The machine we describe is in fact one of many furnished by the Pratt & Whitney Company to the Pope Manufacturing Company for the construction of the gears of the Columbia chainless wheel. As such, it is a special machine adapted to the cutting of one

size of gear only, but it is understood that universal machines upon the same principle are now constructed.

Reference to our issue of December 9, 1897, will show the leading principles of a generating gear-cutting machine, which it is unnecessary to repeat in detail here. It will be remembered that in the system there described a rack tooth, represented by the side of an emery wheel, is traversed past a hardened blank in true rack and pinion motion, and that the result is a correctly formed gear tooth, which tooth is, however, used as a cutter, and is made to itself generate the tooth curves of the actual gears. In the present machine this intermediate operation is dispensed with, the final gear tooth being generated in the first operation, and this being done on unhardened stock, the generating tool is a milling cutter instead of an emery wheel. Just as the emery wheel of the spur-gear system represents a rack tooth, so the milling cutter of the Warren machine represents a crown gear tooth—a crown gear among bevel gears being the analogue of a rack among spurs, and just as a straight sided rack tooth forms an easy starting point for a system of spur gears, so a straight sided crown gear tooth forms a similar starting point for a system of bevels, though not, in the latter case, on the involute system. The involute, as a tooth curve, becomes a straight line in a rack, but not in a crown gear, and the assumption of a straight sided crown gear tooth results in a new system of gear profiles which are peculiar to generated bevel gear teeth—the "octoid" system, which, however, it is unnecessary to do more than note here.

Fig. 1 represents a bevel and a crown gear in mesh, with a development of the outer ends of the teeth below, and an elevation of the same at the left. The action of the machine is based upon the principle that if the crown gear were formed complete and the pinion blank were composed of some soft substance, as wax, and if the two were then rolled together by additional outside gearing, with the motion which they would have if they were completed gears, the teeth of the crown gear would impress in the wax correct teeth outlines to mesh with it. This is accomplished by making milling cutters as represented at *a*, *b* and *c*, take the place of the supposed crown gear. These cutters and the blank are rolled past one another in short reciprocating strokes, equal to the arc of contact of the gear teeth in action, the cutters being meanwhile fed lengthwise of the tooth.

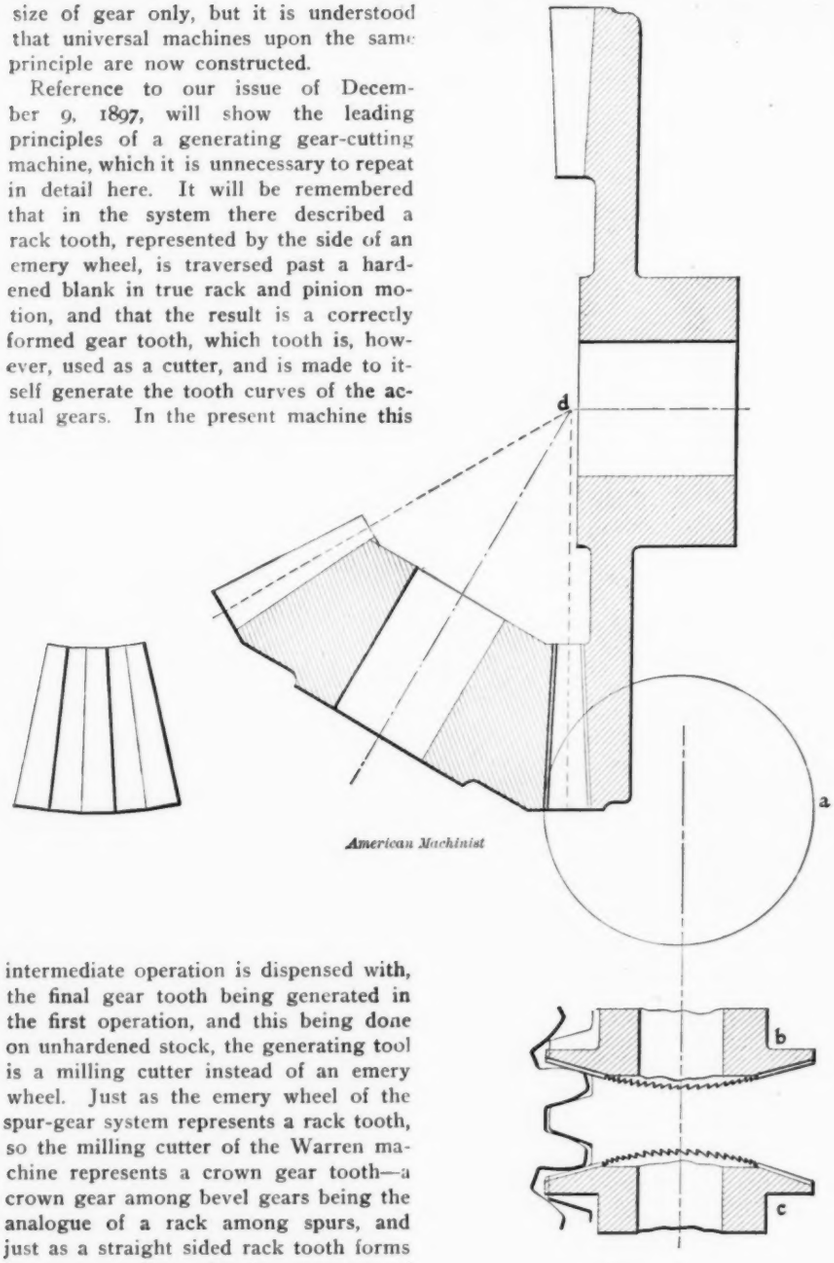


Fig. 1.

CROWN AND BEVEL GEARS AND ACTION OF CUTTERS.

It is obvious from the tapering form of the teeth that a cutter could not be made to cut the two sides of a space at the same time, as such a plan would necessarily make the spaces cut of equal width throughout their length. But one side of a space is therefore acted on at once, but to accomplish the required speed of cutting both sides, two cutters are used which act on the outer sides of adjacent teeth, as shown in the sectional view of the cutters sketched in Fig. 1, in which the view is from below, the feed of the cutters along the teeth being toward the observer. While the axes of the cutters are in line, as seen in this view, they are not so in a view at right angles to this one, their directions being in a line perpendicular to the lengthwise directions of the sides of the teeth being acted upon. This is shown more clearly in Fig. 2, which is a front elevation and plan of the machine, *a* being the blank operated upon, while *b* and *c* are the cutters. The teeth being cut are vertical in these figures, and the feed of the cutters lengthwise of the teeth is on the

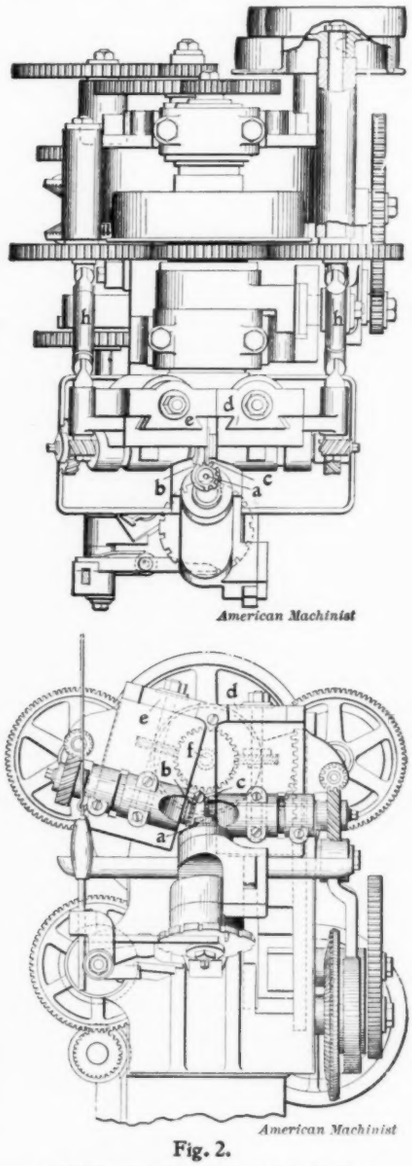


Fig. 2.

FRONT ELEVATION AND PLAN.

slides *d*, *e*, which will be seen to converge and to lead the acting faces of the cutters toward the common cone center *d* of Fig. 1, which is at *f* of Fig. 2. At the same time that this is being done the entire head carrying the slides *d e* and the cutters is oscillated about the axis *f*, while the gear blank is also oscillated about its own axis. The manner of mounting the slides *d e* to permit this movement will be seen in the sectional view of Fig. 3, where the slides are shown mounted on a stiff shaft *g*, the oscillation of which about its axis carries the cutter slides with it. The rotation of the cutters, while being fed along the slides, requires a flexible connection with the driving gear and this is provided by the familiar gimbal jointed telescopic shafts seen at *h* of Fig. 2.

It is unnecessary for us to go into the minute details of the mechanism of the machine, whereby all the required motions are obtained. Suffice it, therefore, to say that they are of a high order of ingenuity throughout—the machine being fully automatic, taking care of the indexing as well as of all of the feeds when once the blank is inserted—the operator's attention being called to the completion of a gear by the ringing of a bell, as with ordinary gear cutters, and the machine automatically stops itself. Nothing, in fact, has been omitted in this respect—a quick return of the cutters on the completion of a cut being provided as usual. The appearance of the completed machine will be seen in Fig. 4, which is from a photograph.

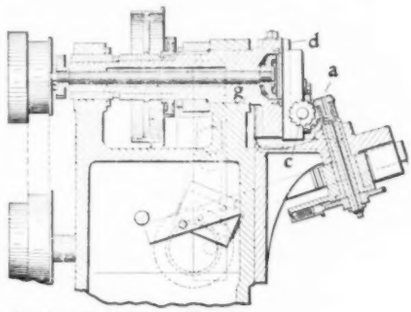


Fig. 3

SECTIONAL VIEW.

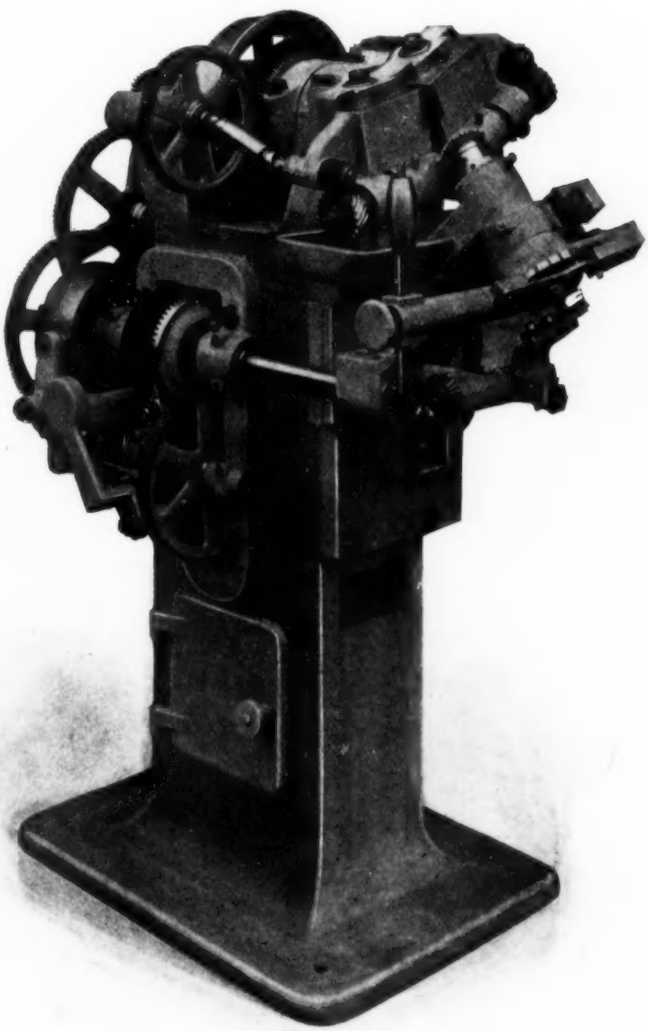


FIG. 4.—THE WARREN BEVEL GEAR CUTTER.

▲ ▲ ▲

To Distinguish Iron from Steel When in Thin Sheets.

We have received the following inquiry:

Is there any way of distinguishing sheet iron from sheet steel when it is too thin to see the grain?

We referred this inquiry to Mr. Gus C. Henning, whose specialty is the determination of the characteristics of materials, and he replies as follows:

There are ways of doing this, but it is not always an easy or a simple thing to do. In fact, some cases will be found to require an expert, with special appliances adapted for such work. Other cases are easily decided, but it should always be borne in mind that steel and iron vary as much as bronze or the so-called babbitt metals, and a test that will answer in one case will not answer at all in another, and the untrained examiner will generally not be able to reach certainty in applying tests. The following, however, may be found useful:

First—However thin the sheet may be a microscope will suffice to see lamination and cinder, if they exist; if both are missing the material is "steel." If the latter only is missing, it *may be* steel.

Second—Dip strips of the metal into muriatic acid for a few minutes, depending upon their thickness; then wash in water and place in a solution of potash. Wash and scrub to remove all scale. If iron, the clean surface will show cinder seams, although a strong glass may be necessary to see them. Seamy steel may also show lines, but different from the above.

Third—Dissolve these thoroughly cleaned pieces in muriatic acid; if steel, no black residue will appear; nearly all iron leaves a black residue.

Fourth—Take chips in a lathe or planer, which can be done even with very thin metal by a skillful mechanic. If the chips are smooth and continuous, they are steel; if checked and breaking into short pieces, they are generally iron. Very perfect cutting tools are necessary.

Fifth—Make tension test and determine modulus of elasticity, elongation at maximum load and character of fracture. If iron, the modulus will not exceed 26,500,000; elongation at maximum load will be almost equal to that after rupture. Fracture will be rather rough and irregular. In case of steel the modulus will be above 28,000,000 at loads up to ¾ of elastic limit. Variation of elongation at maximum load and after rupture will be considerable. Fracture will be "cup shaped."

Sixth—Make tension tests of strips after heating them very carefully to red heat in a gas fire (not covered by coal), and cooling in air. Tenacity will be very much decreased if iron, but much less so if steel; relative elongations are very much changed if steel and increased much more than if iron.

Seventh—Make bending tests, forward and back in vise, having edges rounded. If iron, a few return bends will break it, showing seams. If steel, a great many bends will be required; angle of bend to be 45 degrees in either direction.

Eighth—Make bending test in both directions, with and across the grain. If iron, it will break much quicker in one direction than in the other. If steel, it will be nearly the same in both directions.

Ninth—If strip is held in true direction of N magnetic pole, and sharply rapped once on end by a hammer, magnetic poles will be developed if the metal is steel.

Tenth—Anneal a strip carefully, remove all scale by pickling as before and place on a magnet for twenty-four hours; if it is iron it will lose its magnetism in a short time after removing from the sphere of action of the magnet; if steel, it will retain its magnetism for a long time.

There are many other tests that might be applied, but as you can hardly publish a treatise on the subject, the above will probably suffice.

▲ ▲ ▲

Nickel Steel for Crank Pins and Axles.

If an engineer wants material to sustain severe usage in the nature of alternating stresses he should select a material possessing a very high elastic limit. It is not unusual to find engineers who prefer to use wrought iron for their locomotive crank and cross-head pins and axles in preference to steel, because, as they say, "steel being crystalline is brittle and snaps off suddenly under such service, while iron, having fiber, is tougher and yields before breaking."

There is not one of them who would advocate the use of the old "cut nail," which was made of iron, in place of the "wire nail," which is made of steel. The fiber in wrought iron is due entirely to the slag which could not be eliminated from it in the process of its manufacture.

All metals, iron and steel among them, are initially crystalline. We hear of many forgings having failed in the past from a mysterious so-called "crystallization from shock" or "vibration" in service. We all ought to know that metals crystallize only in cooling from a fluid to a solid state, and that any unusual crystallization shown in a fractured forging was there when the forging was made and was due to improper heat treatment during manufacture.

There is no longer any mystery about the breaking of steel. If the coefficient of elasticity of the metal exceeds by a large factor of safety the external stress applied the life of the material will be long. In other words, the stronger the material the longer it will last under any given service. The cause of the final failure to longer endure the stresses applied is the gradual overcoming of the internal molecular force of cohesion. This gradual weakening of the metal has been given the name "fatigue." Iron and steel are more amenable to the known laws of the universe than we had previously given them credit for being; the same laws of nature under which "continuous droppings will wear away a stone" are applicable to these metals.

The rupture of a bar of wrought iron by *tension* is caused in any of the followings ways:

By 1 application of 55,000 pounds per square inch.

By 800 applications of 51,500 pounds per square inch.

By 107,000 applications of 47,000 pounds per square inch.

By 341,000 applications of 42,500 pounds per square inch.

By 481,000 applications of 38,000 pounds per square inch.

A piece of spring steel, subjected to *bending*, broke as follows:

Under 81,000 applications of 95,000 pounds per square inch.

Under 154,000 applications of 85,000 pounds per square inch.

Under 210,000 applications of 75,000 pounds per square inch.

Under 472,000 applications of 65,000 pounds per square inch.

Under 539,000 applications of 58,000 pounds per square inch.

Under 1,165,000 applications of 53,000 pounds per square inch.

Speaking generally regarding iron and steel for any given stress, a certain number of repetitions produce failure; the greater the intensity of stress the smaller the number of repetitions. We know also that the stress required to cause failure is less, and, roughly speaking, only one-half as great when the metal is strained alternately in opposite directions, as in crank-pins, axles, etc., as where it is strained in one direction only, as in eye-bars of bridges. The more the metal is maltreated the shorter the time it will endure. If we can make the "range" of stress low enough a practically unlimited number of repetitions is required to cause failure.

Numerous tests have been made by revolving long bars supported at both ends and with a weight in the middle, thus imitating those conditions which occur in actual practice in such machine parts as railway axles, engine shafts, crank-pins, etc., where the fibers of the metal are subjected to stresses, continually varying from tension to compression. It has been found from these tests that within a certain limit, which is approximately one-half of the ultimate strength, the metal is elastic, and that if strained beyond this point its working strength is exceeded and it can no longer be depended upon to sustain even minor loads. The fact that a metal possesses a certain elastic limit, elongation and contraction of area, when ruptured by once loading, fails to convey an adequate idea of what the same metal will do under circumstances of repeated stresses, or when these stresses are applied in alternate directions, as they are in practice. These "endurance tests," therefore, have been made in connection with the usual standard tests above mentioned in order to determine the relations that exist between the two.

Following are the results of tests on bars broken from time to time during the past few years at the Watertown Arsenal. The records of the wrought iron bars

Fiber Stress, Pounds per Square Inch.	40,000 Revs.	35,000 Revs.	30,000 Revs.
Wrought Iron breaks after	59,000	175,000	625,000
.15 per cent. Carbon Steel breaks after	170,000	765,000	.....
.25 per cent. Carbon Steel " "	229,000	.....	.....
.35 per cent. Carbon Steel " "	317,000	5,100,000	.....
.45 per cent. Carbon Steel " "	976,000	.....	.....
.55 per cent. Carbon Steel " "	.....	9,600,000	.....
.65 per cent. Carbon Steel " "	3,689,000	.....	.....
.75 per cent. Carbon Steel " "	.....	15,000,000	12,550,000
.85 per cent. Carbon Steel " "	.....	19,000,000	16,300,000
.95 per cent. Carbon Steel " "	.....	.....	.....
1.05 per cent. Carbon Steel " "	.....	.....	50,000,000 (Not ruptured.)
3¼ per cent. Nickel Steel, carbon .25 per cent. to .30 per cent	1,850,000	.....	.....
4½ per cent. Nickel Steel, carbon .25 per cent. to .30 per cent	2,360,000	.....	.....
5½ per cent. Nickel Steel, carbon .25 per cent. to .30 per cent	4,370,000	.....	.....

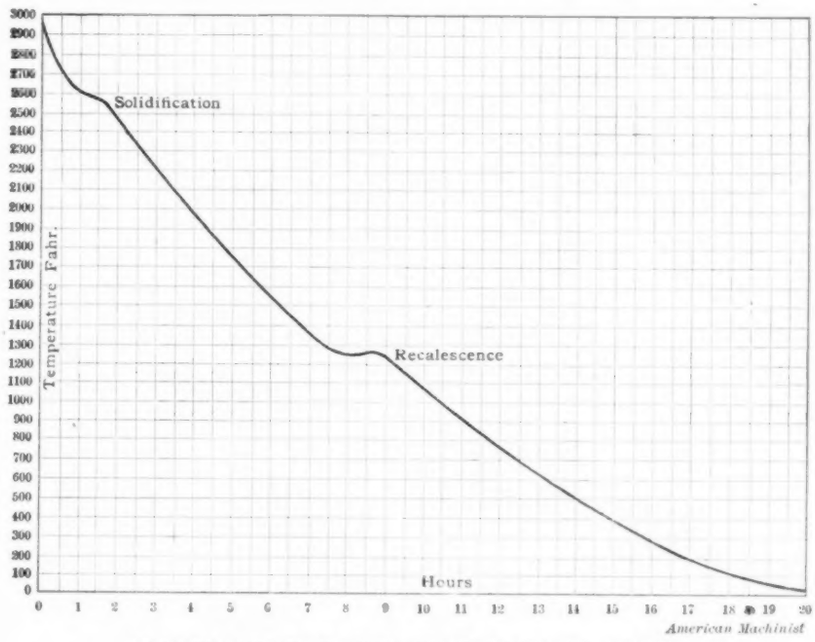
Following are the results of tests on bars broken from time to time during the past few years at the Watertown Arsenal. The records of the wrought iron bars

*Condensed by and for the "American Machinist" from a paper by H. F. J. Porter, M. E., the Bethlehem Iron Company, South Bethlehem, Pa.

are the average of a large number of tests:

These results, which are representative of many, show that the material, after a certain number of repetitions of stress within the elastic limit, breaks with fewer subsequent repetitions.

It would naturally appear likely that any gradually progressive alteration or "fatigue" of the bar would be manifested in some way in alteration of the ultimate strength, elastic limit or elongation of the metal when tested in the ordinary way. This, however, does not appear to be the case. A bar subjected to so many repetitions of loading that it is known to be on the point of breaking, or a piece of bar already broken in an "endurance" test, gives in the ordinary testing machine no indications that its strength or ductility has been altered. Careful consideration of the results of endurance tests so far made leads to the recommendation of material for forgings, if they are to be subjected to frequently alternating stresses, which shall have a very high elastic limit, and that they shall be so proportioned that these stresses shall at all times lie far within this limit. Steel, not wrought iron, should be the metal used, and the higher the carbon content of the metal the higher will be the limit and the longer will be the life of the piece. A low percentage of nickel in its composition will increase its life still further.



COOLING CURVE OF STEEL FROM THE LIQUID STATE

Referring to the diagram, if we note the rate of cooling of a steel ingot from the point of solidification to coldness we will see that the temperature will fall regularly nearly the same amount in equal divisions of time, until, between 1,300° and 1,200° Fahrenheit, a point (depending on the carbon content) is reached where the temperature suddenly stops falling, and either remains stationary or perhaps rises for a short time, and then the rate of cooling continues regularly. This point, where the change of rate takes place, is called the "recalescent" point, and from chemical and physical tests we know that a change in the structure of the steel occurs here.

The fluid steel begins to crystallize at the point of solidification, and the slower the rate of cooling from there down the larger the crystals will be when the ingot is cold. At the point of "recalescence," however, it would seem as if the crystallization, so to say, *locks itself*, for after the ingot has become cold, if we reheat it to a temperature *below* this point, on again becoming cold we will find that the crystallization is not affected, but if we reheat it a little *above* the recalescent point, when it is again cold the crystallization will be found to be much smaller than before.

In the forging process, beginning with the cold ingot (which we will assume has cooled slowly and is therefore composed of large crystals), we first reheat it up to a forging temperature of from 1,800° to 2,000° Fahrenheit, thus destroying all crystallization, and producing an amorphous condition. As we put it under the forging press it begins to cool, crystallization at once setting in. The work of forging tends to check crystallization just as the disturbing of water which is below freezing point will delay the formation of ice crystals. The work of forging may or may not continue until the temperature has fallen below the recalescent point, but more or less crystallization has occurred, and has been disturbed and distorted. The work of forging has, moreover, proceeded from one end of the piece to the other, so that the two ends may be entirely different as far as their internal condition is concerned. The forging is now full of pulls and strains about which we know nothing. The extent of the strains is made evident when a forging, finished as above described, has a cut taken from it in a lathe or has a key-way cut on one side. The strains in the fibers which are cut are relieved and the piece invariably springs out of "true."

To relieve these strains the forging should be carefully and slowly heated to a temperature slightly above the recalescent point, and then allowed to cool slowly. If the forging, on being heated slightly above the recalescent point, is suddenly dropped into a bath of cold oil, no time is allowed during the cooling process for crystals to form, and the amorphous condition of its structure at that temperature is retained. This character of heat treatment is called "oil-tempering," and is followed by further heat treatment to relieve the metal of any hardening effect due to the cooling process. Annealing lowers the ultimate strength and elastic limit of steel, but increases its ductility. Oil-tempering not only restores the ultimate strength and elastic limit, but increases the elongation and contraction very considerably. The very best steel suitable for forgings will not last indefinitely under a fiber stress of 40,000 pounds per square inch, and the life of wrought iron and mild steel under even lower stresses is comparatively short.

Crank-pins, axles, etc., are generally made of material which has initially little strength to resist fatigue. They are loaded up during the process of forging by stresses which may closely approach the elastic limit before any stress whatever is put upon them from outside. A severe compression stress, sometimes itself closely approaching the elastic limit, is applied to the metal by the process of forcing them into wheels, and it is not surprising that their life is short at the point where this stress is applied. For such service as is required of crank and cross-head pins, axles, piston and connecting rods and all forgings subject to stresses alternating from tension to compression, a metal possessing the very highest elastic limit possible should be supplied.

We must be sure that our forgings are free from internal strains. We must also so proportion them that these stresses will be well below the elastic limit of the metal if we desire to insure lasting qualities, remembering that range of stress when the stresses are alternating has a double value.

The first practical application of the improvement in the quality of steel by

the use of nickel was in the production of open-hearth armor plate. This alloy increased the toughness of steel of a given hardness or tensile strength so as to add greatly to its resistance to cracking from the shock of projectile impact. An examination of the physical characteristics of this metal shows it to possess valuable qualities which explain its toughness and resistance to shock. The nickel, replacing part of the carbon, with a given tensile strength increases the elongation, and to a greater degree the contraction of area, in test pieces at the point of fracture. Its effect upon the elastic limit, however, is of the greatest importance, as it raises this quality in a marked degree relatively to the tensile strength, and thus insures a combination of elastic strength and ductility unknown in any other metal. The presence of the nickel also renders the steel sensitive to the good effects of tempering, and the desirable qualities above mentioned are accentuated by this treatment. Endurance tests show that this metal is eminently adapted to resist fatigue, and experience in actual practice confirms these tests.

Test bars of this metal ½ inch in diameter and 2 inches long between measuring points show the following physical properties:

Tensile strength, 80,000 to 95,000 pounds per square inch.

Elastic limit, 50,000 to 65,000 pounds per square inch.

Elongation, 25 per cent. to 22 per cent.

Contraction, 60 per cent. to 50 per cent.

Many railroads are now taking up the use of this metal generally, having tested it experimentally and found to their satisfaction that by a small initial increased expense they can save largely by having fewer breaks with their attendant delays and damage.

▲ ▲ ▲

The Pennsylvania Steel Company, at Harrisburg, Pa., now has on its payrolls 5,000 names, a gain of 1,218 over a year ago.

▲ ▲ ▲

The Philadelphia Exposition Association has issued a prospectus for an exhibition of American manufacturers which is to be opened in Philadelphia, May 10, 1899, and remain open for five months. American manufacturers will be properly classified and displayed in one department of this exposition, while another department will comprise exhibits of European manufactures, which will be selected by competent specialists, with the object of showing the requirements of different export markets. Another department will be devoted to showing proper methods of packing for shipment to foreign countries. William Harper, 233 South Fourth street, Philadelphia, Pa., is director-general.

The Helicoid Lock Nut.

An extensive plant for the manufacture of this nut has been established in England, and the nut and its manufacture are simultaneously illustrated and described in our esteemed contemporaries, "Engineering" and "The Engineer," London. The nut, one form of which is shown in Fig. 1, is formed by coiling on a mandrel a strip or rod of cold steel. The nut is tapped somewhat smaller than the bolt on which it is used, and the spring of the metal holds the nut securely. The invention, although thus elementarily a simple one, has involved a great amount of thought and of supplementary invention to make the nut a practical commercial possibility.

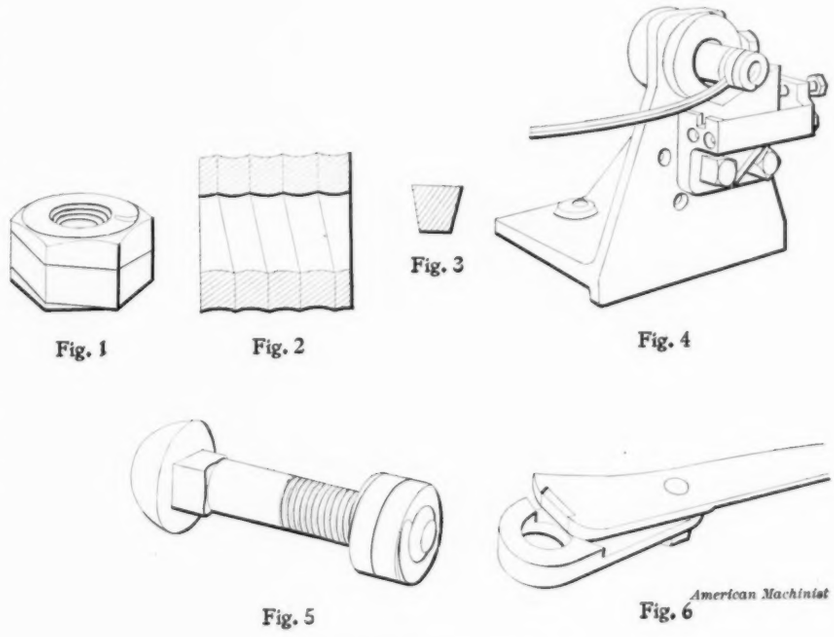
If square rod was used, or rod of any rectangular section, it would be concave on the outside and convex on the inside, something as in Fig. 2. The rods are accordingly rolled with a section as in Fig. 3, and after winding the coils lie snug against each other with nearly cylindrical surfaces both inside and out. The nuts are not wound separately, but in long coils, each nut being then sawed off, all the operations being done cold. The strips before winding are 30 or 40 feet long and the coils are from 3 to 5 feet according to the size of the nut.

The essential part of the winding apparatus is shown in Fig. 4. This is the upper part of a lathe footstock, which is free to slide back bodily along the ways as the winding proceeds. A long round mandrel, not shown, runs through the center of the coil. It is driven by the live spindle, and the first end of the rod is also caught at the live spindle end and carried around with the mandrel, and as the winding proceeds the footstock is naturally crowded backward. The rubbing wedge may be adjusted by the screw at the back to give the necessary tightness to the coil. For a right-hand nut the rod is coiled with a left-hand helix, and *vice versa*.

The nuts are individually sawed from the coil by power driven hacksaws, a large number of them being employed in the works, and forming, when seen together, a striking and peculiar collection of machinery. It is understood that these hacksaws are to be finally superseded by circular saws.

Many of the nuts are used round for fishplates and such service, as in Fig. 5, and the wrench, Fig. 6, is then used to screw them up. The wrench is used for either screwing up or unscrewing by simply swinging the serrated gripping jaw to one side or the other of the central line.

The nuts are all tapped in the round, and the flatting of the sides for squares or hexagons is done in special machines, into which the nuts are fed continuously. It is stated that the sides are sheared each by a single cut. The nuts are afterward finished with emery wheels and polishing laps when so required.



THE HELICOIDAL LOCK NUT.

▲ ▲ ▲

"The Engineer," London, will, if its dictum is accepted, be the means of preventing a lot of futile experiments. It says first that "steam is the best possible agent for the propulsion of vehicles on common roads," and, second, "about this" (the fuel) "there is no room for question. It must be liquid fuel." This narrows the scope of future investigations to a minimum.

Shop Tools Driven by Compressed Air.—I.

We have reason to believe that comparatively few of our readers are fully informed of the number and variety of tools to be driven by compressed air which are now offered for their use, nor of the extent to which they are already employed, and we cannot but feel that we can be of service to a wide circle by bringing these things to their notice.

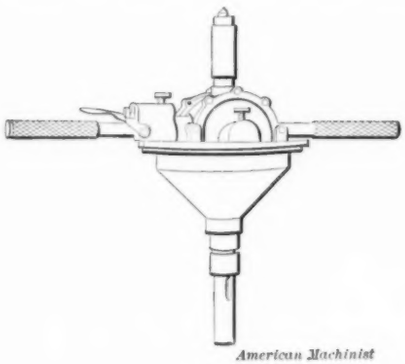


Fig. 1

THE HAESELER PNEUMATIC DRILL.

The tools which we now have in mind are mostly portable, the air being conveyed to them usually by flexible hose, and the tools movable from point to point continually. Our friends who stand all day by the lathe or the planer or the radial drill may perhaps think that the field for the employment of portable tools is a small and a constantly narrowing one; but precisely the reverse of this is true. The field is already a large one, and it is constantly widening. In bridge building and shipbuilding portable tools are employed for a large portion of the work. In locomotive building and in heavy steam engine work, and on other large machinery, such tools also are extensively employed, and pneumatic tools are in many cases used for practically every operation of the boiler shop, so that altogether there is opportunity for an enormous number of pneumatic tools.

The first tools that we mention are those which impart rotary motion, and which are employed to drive drills, reamers or taps, to drive in staybolts and such uses. These all embody an air motor, usually of the rotary type, and not exempt from the objections to the rotary steam engine in general. They do not use the air economically; they leak more or less (generally more after a while), and the packing gives out, but while they last they will go, every time the air is turned on, and this is often the point of greatest importance.

A pneumatic tool with a rotary motion is shown in the accompanying cuts. This tool is made by the C. H. Haeseler Co., Philadelphia, and is designated as No. 1 and No. 3 Phœnix. Fig. 1 shows the general external appearance of the tool, and Figs. 2 and 3 are sections showing the construction. This tool is well balanced and easy to handle. The hose is atached to one end of the cross handle, and with a gage pressure of 60 pounds will drill holes up to 1½ inch in soft steel. The thrust of the cutting tool is always central and the speed is under the instantaneous control of the operator by means of the thumb lever at the side. Each tool is furnished with a chuck for driving square shank cutting tools and a chuck for taper shank tools with No. 3 Morse taper. The weight of the machine complete is 42 pounds. Fig. 2 is a vertical section through the axes of the cross-pipes or handles, showing the general principle of the motor. The air enters at the right, and striking one of the blades of the revolving drum, drives it around until the second blade comes into play, and so on continuously. The exhaust occurs through the other handle. The blades are held out in contact with the periphery of the shell by means of a wire spring between them shown in the center of Fig. 3. This figure is a vertical section through the journals of the motor and at right angles to Fig. 2. A small bevel pinion on the right-hand end of the rotary piston hub meshes into a large bevel gear face, which is a part of the lower shell of the machine, which thus, it will be seen, all revolves, the chucks for holding the tools being screwed upon the lower end or hub. The long feed nut on the upper shank has two cross handles by which it may be turned. The chucks for the taper and the square shanks of the tools are shown below Fig. 2.

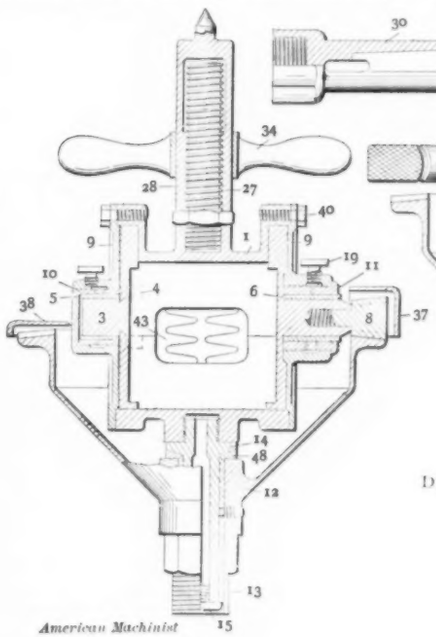


Fig. 3

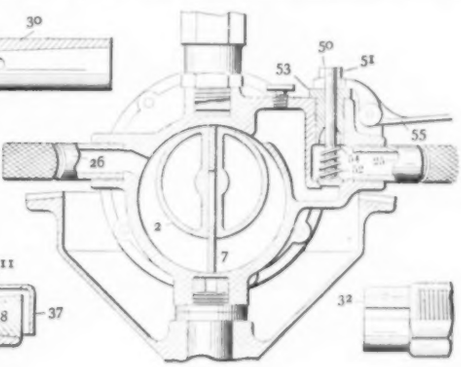


Fig. 2

DETAILS OF DRILL AND MOTOR.

Fig. 4 shows a breast drill made by the same company, which requires little explanation. The motor of this drill is similar to the preceding, except that it has a vertical axis and the drill chuck is connected directly to the hub of the rotary piston without gearing. This will drill holes up to ½ inch, and is especially handy for drilling centers in heavy lathe work, drilling holes for small taps and screws in jacketing cylinders, putting on name plates and similar work. It will drill as rapidly as any sensitive drill press. The weight of this machine complete is 18 pounds.

▲ ▲ ▲

The Boston Mechanic Arts High School.

The report of the Mechanic Arts High School of Boston, Mass., is an interesting document, and the institution represented seems to be a thoroughly equipped and in every way an admirable one. Any boy who has been graduated from a Boston grammar school is entitled to admission. The value of the course thus gratuitously provided by the city of Boston for its favored sons is partly evidenced by the fact that the cost of the course to non-residents is about $80 a year. It is the aim of the mechanical departments of this institution to

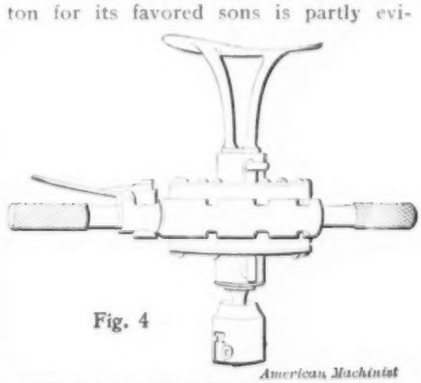


Fig. 4

THE HAESELER PNEUMATIC BREAST DRILL.

teach in a thorough and systematic way the elements of carpentry, joinery, wood carving, wood turning, pattern making, forging of iron and steel, chipping, filing, fitting and machine tool work. For each department a carefully graded series of models has been chosen, the construction of which illustrates every fundamental principle or process, and the tool equipment has been selected with a view to its precise adaptability to the course pursued.

The machine shop equipment is as follows:

Three 14″ lathes, eighteen 12″ lathes, one 20″ planer, one 14″ shaper, one No. 2 Universal milling machine, one Universal hand lathe, four 10″ hand lathes, one 20″ upright drill, one sensitive drill, one tool and cutter grinder, one wet and dry grinder, two grindstones, one power hack saw and twenty-four hand lathes, being built by the pupils.

All the necessary small tools are liberally provided. The actual lathe and planer tools used are of course made by the pupils. Each lathe has chucks, sets of dogs and all necessary fixtures, and the tool room has a full supply of small tools, drills, taps, etc., so that whatever class of work is in hand no one will have to wait his turn. There is a demonstration lathe, with blackboard and seats, for the class, where full instruction is given in the theory of the various processes.

Every other shop is as completely equipped as the machine shop. The pupils usually work in one shop one hour and a half a day, and three classes are thus enabled to go through the same course at once.

The report above referred to calls attention to the distinction between a trade school, which this institution distinctly is not, and a manual training school of which it is an excellent example. A trade school aims to teach as thoroughly as possible some special trade. No instruction is given that does not bear directly upon this chosen trade. The manual training school, on the contrary, teaches the elements of the mechanic arts primarily on account of their general educational value, just as arithmetic and geometry are taught. These things have a great trade value. The elementary but systematic knowledge of the entire field of the mechanic arts gives those who have acquired it the same advantage in dealing with the difficult problems of any trade that a liberal education gives to the student of law or medicine. As a matter of fact a large percentage of the graduates of manual training high schools readily find employment in desirable positions in which their mechanical training proves of very great service.

▲ ▲ ▲

William E. Aughinbaugh, of Chicago, Ill., has been disbarred from practice before the United States Patent Office "for gross misconduct."

That Patent Experiment.

Editor American Machinist:

By referring to the "American Machinist" of January 27 you will find an article written by Frank Richards, headed a "Patent Experiment." In this article Mr. Richards claims to have sent us a tracing of the drawings of a patent procured by him in 1866, and that we reported the invention patentable. He also publishes an extract from a letter of ours, which, without its context, and without mention of the fact that he had previously written asking the number of our clients, puts us in the attitude of boasting that we have 15,000 clients.

We assume for the present that it is not the intention of the responsible head of your paper to do us injustice, and we think you will find on investigation (the more thorough the better), that we have been wronged intentionally (and it seems to us maliciously), by placing our name in juxtaposition and classing our practice with that of the notorious John Wedderburn, and by publishing only extracts of our letters, and failing to publish the letters of Richards which elicited ours.

It is apparent, we think, from the correspondence that Mr. Richards started out to entrap us, and adopted methods better suited to a low class of sensational journalism than to the pages of a scientific publication. At any rate, he made us believe he was an inventor seeking a patent. He claims in the published article that he sent us a tracing of Fig. 2 of his patent. That he did not send a tracing of Fig. 2 the photograph herewith enclosed will show. On receipt of this tracing we ordered a preliminary examination by Mr. B. G. Foster, in our employ, and after a *very careful examination* he failed to find the Richards patent, and we reported the device embodied in the tracing in our opinion patentable, and offered, according to our terms, to prosecute the application, making our fee contingent upon success in getting an allowance of patent. A slight study of our contingent fee system will convince anyone that we cannot in our own interest report an invention patentable unless we actually believe it to be so. We get no remuneration unless the result justifies our report.

But how was it that we reported Richards' patent of 1866 patentable? We did not do so. Richards sent us but one figure—Fig. 2 of this patent, and this traced in such a way as to disguise its resemblance to the original. From the subsequent course of Mr. Richards we are disposed to think that this disguise was not *accidental* but *intentional*. The sun print of the alleged tracing and the copy *enclosed herewith* of the patent will justify this statement.

There is another way in which a searcher making a preliminary examination may be led to report a clearly anticipated device patentable, namely, when the copy of the anticipating patent has been removed from the portfolios, as it often is, by the Patent Office examiners and clerks, and in this way escapes the scrutiny of the searcher. We do not accuse Mr. Richards of removing or having a confederate remove the copy from the files before he came to us in the guise of an inventor seeking assistance; but such practice, we submit, would not be inconsistent with his methods, apparent in publishing only garbled extracts from our letters, in omitting to publish his own letters asking us for the information about the number of our clients, in *classifying* us with a firm that has been disbarred and fraud-listed, and finally in publishing a correspondence that was *private* and *confidential*.

We lay this matter before you. It will be easy for you to learn that we are solicitors of long, successful and fair practice, and that we are responsible in the broadest and best sense of the word. We ask you to afford us such reparation as your sense of fairness suggests, either by publication of this letter or an apology, and that you protect us in the future in your columns from *malicious misrepresentation*. C. A. SNOW & CO.

Washington, D. C.

[We do not wish to be unfair to anyone, and to avoid the appearance of unfairness print the above statement. It has, however, evidently been written without a full knowledge or appreciation of all the facts of the case.

It is not true that Mr. Richards claims in his article to have sent Snow & Co a tracing of the drawings of his 1866 patent. The statement by Mr. Richards is distinctly different from that, and Snow & Co. are evidently mistaken on that point. What Mr. Richards says is that he sent to several solicitors tracings of a new sketch, which sketch was shown in our columns, with the drawing of his 1866 patent, and together they show their points of variance. It was intended that the two drawings should look different from each other at a mere casual glance, but that they should actually be mechanically similar, *i. e.*, that both should represent identically the same mechanical device to be used for the same purpose. Those who will take the trouble to refer to them will readily see that this object was actually attained.

There could not well have been any malicious intent in this matter. Many patent attorneys offer to make preliminary examinations as to the patentability of inventions. Some of them offer to make them free of charge, others to make them for $5. The intention of Mr. Richards was simply to find out the value to an inventor of these preliminary examinations.

A very slight study of the contingent fee system does not usually convince anyone, as Snow & Co. say it does. On

the contrary, it is the general belief among well-informed people that the contingent-fee system is a strong temptation to the practice of imposition upon inventors, and that this is often its direct result. Patent solicitors of good standing generally condemn it.

It is a fact that Snow & Co. did report the invention of 1866 patentable, notwithstanding their denial of having done so. The so-called "disguise" of the later drawing would have deceived no fairly competent searcher, aiming to make a real examination.

These points and others brought up by Snow & Co. are answered by the following statement of facts in the form of a resumé of the case.

It happened that our Mr. Richards had in his own name a patent for a balanced valve, thirty years old and long ago expired. A simple sketch and description of this valve, embodying and clearly explaining its essential features, were prepared. This sketch and description were reproduced on page 24 of our issue of January 17, and our readers, who are very well able to judge of such matters, can readily decide whether they did not fairly and clearly represent the valve of the old patent. The sketch and description were sent out precisely alike to six of the most prominent and best-known patent soliciting firms with a simple note asking for a preliminary examination. Three of the firms offered to make the examination for nothing and three of the firms each charged $5 for the service, and the $5 was in these cases paid. The correspondence in the case of the first three was conducted by Mr. Richards in his own name; the other three were in the name of another person. Not one of the six firms, not even C. A. Snow & Co., offered the slightest objection to the sketch and description as lacking in clearness or intelligibility when acknowledging receipt.

The final result with regard to the first three firms has already been stated in our columns. There has been no garbling and no concealment. Everything pertinent and necessary to a clear understanding of the case has been given. We are entirely at a loss to understand what Messrs. Snow & Co. have to object to in the statement as to the number of their clients, and we cannot see that it is necessary for us to say a word upon that subject. Our complete vindication in the matter of the principal grievance may be found in the simple fact, not heretofore published, that the report of each of the three firms not given before was that the valve was not patentable, and each sent a copy of the original Richards patent as a reference. The names of these firms can be given if it seems desirable or advisable to do so.—ED.]

▲ ▲ ▲

One of the problems of to-day is what to do with liquid air.

Col. Mordecai and the Springfield Armory.

Editor American Machinist:

We are much surprised and pained to read your sweeping criticism of the administration of Colonel Mordecai, late commanding officer at the Springfield Armory. Into the merits of the question, whether or not an armory should be directed by a military man, we will not enter. But when a man is attacked, for whom we have had great respect, in such an insinuating and wholesale way as you have done in the "American Machinist," we think it our duty to say a word in his defense.

Colonel Mordecai has impressed all the men from these works who have come in contact with him as a thoroughly hard-working officer, who was possessed of considerable mechanical ability. To assert, as you do, that "to pretend that either of them knows much of manufacturing operations in a practical way is an absurdity," is a gross error, in so far as Colonel Mordecai is concerned. On the contrary, we believe he has introduced reforms in the armory which are saving the Government thousands of dollars.

We know nothing of his control of the working force of the armory during the past few months. When he first went there we do know that he found a lot of deadheads who were filching large wages out of the Government for a small quantity of work. To rid the armory of this class of pensioners was his constant endeavor, and during successive visits we were pleased to notice a constant improvement in the working force of the plant.

That he is a strict disciplinarian is to his credit as an army officer, and our observation has been that his discipline was appreciated as for the best by those who worked under him.

To conclude, we believe you have lodged your protest against "military red tape" in the wrong place; you have done a wrong against a very honorable and able officer, who was giving his heart and soul for his Government's welfare.

BROWN & SHARPE MFG. CO.
Per Henry D. Sharpe.

[Our remarks concerning Colonel Mordecai were not made in total ignorance of how things have been going at Springfield. We know as well as anyone that he has been a conscientious and hard-working officer. But we know a great many men who are equally conscientious and industrious, but who would be utterly out of place in command of an armory. What one thinks of a man in such a position will naturally depend much upon the point of view. It is, of course, true that Colonel Mordecai has corrected some abuses at Springfield, but he has done this in such a way as to get himself very generally disliked, and even those who are most anxious to defend him are substantially agreed that he is wofully lacking in tactfulness. We venture the opinion that were Colonel Mordecai placed in charge of the B. & S. shops one-half or more of the best men in those shops would, within a month, be looking for other places. We happen to know that by no means all of those who have done business with the Springfield armory have had so fortunate an experience as B. & S. evidently have. Complaints from firms of very high standing have reached us regarding the difficulty of doing business there, and it has been said that, though Colonel Mordecai probably meant well enough, yet his methods were such as to make it very difficult to do business with him. We have a considerable stock of information regarding this matter. But for the present we will be content to say only that Colonel Mordecai is merely another proof of what we believe to be a fact—*i. e.*, that men who have had a military training should devote themselves to military matters, leaving gun making and other mechanical matters to those who have had not military but mechanical training.—ED.]

▲ ▲ ▲

Doubling the Efficiency of Compressed Air.

BY FRANK RICHARDS.

The cheapening of anything which is intrinsically useful and of various application must inevitably lead to its wider employment and to the greater benefit of the users. The compression of air, its storage and transmission and its application to various purposes, have heretofore all seemed to be operations so simple as to require little skill or knowledge, and to admit of little range in the economy of the service secured. There has been found, however, quite a wide difference between the best and the worst practice. But even what has been very recently the best is capable of a quite astonishing improvement, as I here endeavor to show. The scheme which I try to set forth is not by any means a purely theoretical one. It has been put into actual operation to an extent at least sufficient to realize substantial gains and to show that there is no mistake in the matter.

The more economical accomplishment of any one, from the first to the last, of the series of operations involved in a complete system of power transmission must increase the ultimate efficiency. In the use of compressed air the cheaper compression of the air is as distinct a gain as would be a more efficient employment of it after compression. In the improvement which the latest generation has witnessed in the economy of the steam engine it has been, perhaps, greater

in the engine than in the boiler; while with compressed air the gains seem to be found more in the boiler, or compressor, than in the engine, or motor, although there is a practical change which affects the entire system in each case. As we all very well know, the enhanced economy of the steam engine has been found principally in the employment of higher pressures. The same means of promoting economy seem to have been adopted all along the line of power development or of power transmission. The Diesel oil or gas engine, also, is now claiming a greatly increased economy by working at higher pressures. Electricity has been compelled to adopt high current pressures to make long-distance transmission practically possible.

Compressed air has caught on to the same idea and improved upon it. In the triple expansion or the quadruple expansion engines it seems to have been the last added part of the pressure that has accomplished the economy, but in the steam engine the entire range of pressures from the bottom has still been retained. The new compressed air system retains and employs only the higher and more profitable part. The essential feature of the system is the constant maintenance of the air empoyed at a high pressure. Instead of constantly compressing fresh atmospheric air to a gage pressure which may be anything up to, say, 100 pounds gage, and at the motor exhausting it into the atmosphere again, it maintains an initial pressure of, say, 100 pounds, compresses to, say, 200 pounds, and at the motor exhausts against a constant back pressure of 100 pounds, the air exhausted being conveyed back to the compressor again under this pressure.

By referring now to the accompanying diagrams, all on a scale of 50 pounds to the inch, though enlarged a trifle in the reproduction, we can easily see the principal features of the new practice. We will have to do principally with Figs. 1 and 2, but it is well to keep Fig. 3 in sight to show the possibilities of the system if carried still further.

Fig. 1 represents the adiabatic compression of a given volume of air from atmospheric pressure, say 15 pounds to the inch, to a gage pressure of 100 pounds. Fig. 2 shows the compression of an equal initial volume at 100 pounds to a pressure of 200 pounds, and Fig. 3 shows the operation of compressing from 200 pounds to 300 pounds. These three diagrams do not represent successive compressions of the initial volume represented in Fig. 1. The weight of air, or the actual quantity of free air acted upon, is successively much larger than in the preceding. Fig. 2, although having the same initial volume as Fig. 1, represents more than seven times the volume of air at atmospheric pressure and Fig. 3 again represents almost double the free air used in Fig. 2.

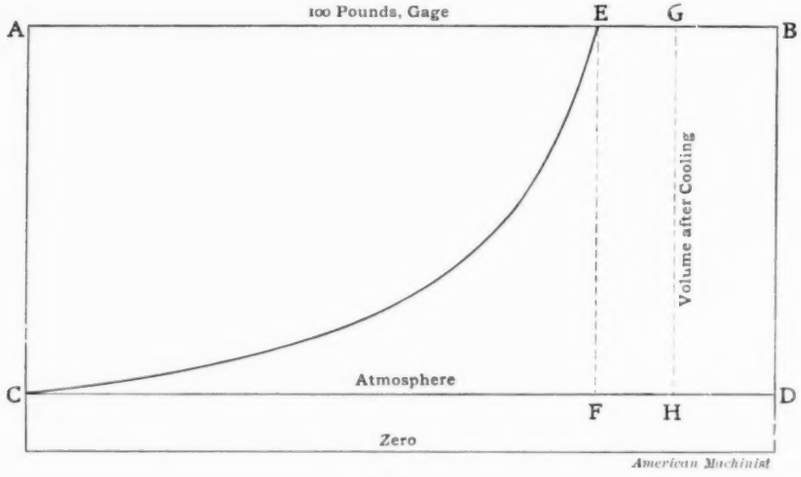


Fig. 1

THE USUAL WAY.

Returning now to Fig. 1, the rectangle *A B C D* represents the initial volume of free air. When compression ceases the volume of air is represented by *E B D F*. The operation of compression has increased the temperature of the air very much. It is impossible to maintain this temperature in the air, or to use it at the high temperature attained. The air may be said to invariably cool to the normal temperature before it is used, and to shrink proportionately, so that the actual volume of compressed air at 100 pounds produced for use, and which can be actually used, is represented by the rectangle *G B D H*, this volume being only about an eighth of the initial volume, and not much more than one-half the volume *E B D F* which was compressed and delivered. The air discharged under either compression here represented may be said to have equal value, volume for volume, for power purposes, that delivered in Fig. 1 being subsequently used against atmospheric pressure only, that from Fig. 2 being worked against a back pressure of 100 pounds gage, and that from Fig. 3 against 200 pounds back pressure, or each with an effective working pressure of 100 pounds. This statement is subject to a qualification as to the mode of using the air, which will be referred to later. In Fig. 2, compressing air from 100 pounds to 200 pounds, the air is not heated by the compression nearly as much as in Fig. 1, and the shrinkage from the volume *E B D F* to that of *G B D H* is proportionately much less than in the previous diagram. The volume *G B D H*, here available for work, is more than one-half the initial volume *A B D C*, or four times the volume delivered in Fig. 1, while the mean effective pressure of the stroke of compression and delivery is decidedly less than double. Here we get fully four times the volume for less than double the power employed, which certainly looks like doubling the efficiency by halving the cost of the compression. This diagram represents the actual advanced practice. In Fig. 3 we have a hint of the possible result if the air were used at 300 pounds against a back pressure of 200 pounds, or with the same available pressure of 100 pounds, as in the other cases. In this case the heating

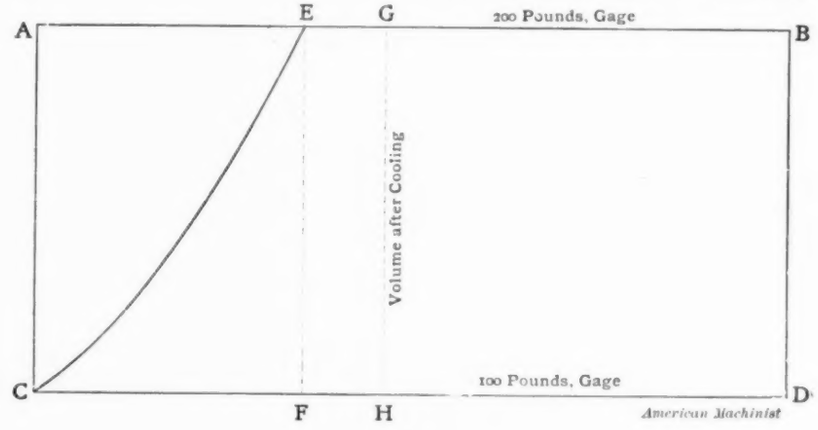


Fig. 2

THE BETTER WAY.

of the air during compression is still less, and the consequent shrinkage by cooling is also less. The available volume delivered, *G B D H*, is more than five times the corresponding volume of Fig. 1, while the mean effective pressure employed for the compression and delivery of the air is less than two and one-tenth as much as in the first case. This seems to be decidedly more than doubling the efficiency.

If I now give the figures in the case without troubling ourselves with the formulas by which they are obtained, they being in the hands of all the scientists, we can see the case still more clearly. First as to the temperatures, it being assumed throughout, which I have not mentioned before, that the initial temperature is 60° Fahr. With the same increase of pressure in each case, 100 pounds, the final temperatures will be 485°, 163° and 121°, the rise of temperature being, respectively, 425°, 103° and 61°.

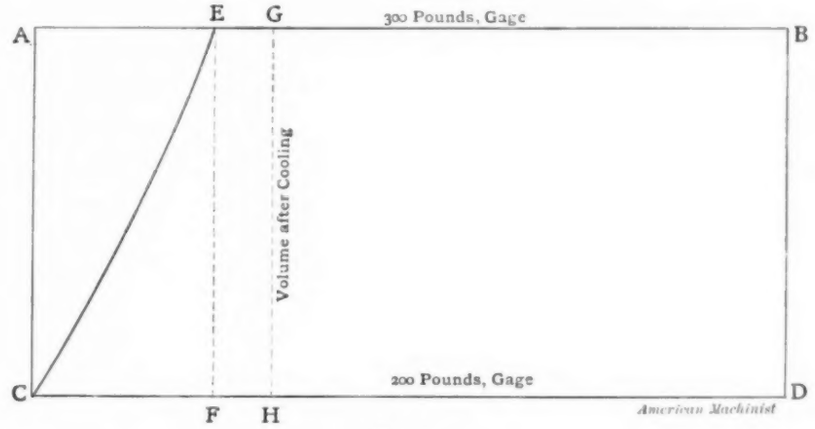


Fig 3

STILL HIGHER AND BETTER.

The enormous rise of temperature in the compression from atmospheric pressure has led to the quite general adoption of two-stage compression, and some gain in economy, at the expense of additional complication in the machinery employed. In the heating that occurs in Figs. 1 and 2 there is no necessity for employing the two-stage compressor, and no possibility of any increased economy through its employment.

The ratio of final and initial absolute pressures is, in Fig 1, 7.666; in Fig. 2, 1.869; in Fig. 3, 1.465. The ratio of initial and final volumes, compressing adiabatically, as here assumed all through, or the ratio of *E B D F* to *A B D C*, is, in Fig. 1, .2353; in Fig. 2, .6413, and in Fig. 3, .7624. The ratio of the volume after cooling to 60°, or the volume available for use to the initial volume is, in Fig. 1, .1304; in Fig. 2, .535, and in Fig. 3, .6825. The relative costs of compression, as measured by the power used, or the mean effective pressures divided by the volumes after cooling are: In Fig. 1, $41.6 \div .1304 = 319$; in Fig. 2, $78.88 \div .535 = 147$; and in Fig. 3, $86.83 \div .6825 = 127$. Here the ratio of the cost in Fig. 1 to that in Fig. 2 is $319 \div 147 = 2.17$, and of Fig. 1 to Fig. 3 it is $319 \div 127 = 2.51$.

If instead of adiabatic compression, which has been assumed all through, when compressing from atmosphere as in Fig. 1, two-stage compression is employed, with efficient intercooling between the stages, the mean effective pressure may be reduced to about the mean between adiabatic and isothermal compression, or we would have for the mean effective pressure of Fig. 1 under the best conditions 35.83, instead of 41.6, which more nearly represents the common practice. Then in comparing the relative costs of compression that of Fig. 1 would be $35.83 \div .1304 = 274$, instead of 319, and the other two as before. Thus the ratio of the cost in Fig. 1 to that in Fig. 2 would be $274 \div 147 = 1.86$, and of Fig. 1 to Fig. 3 it would be $274 \div 127 = 2.15$.

The air delivered as represented by either diagram has the same surplus pressure of 100 pounds, and for the ordinary purposes for which the air is employed, as, for instance, in driving rock-drills or direct acting steam pumps, the air supplied is of the same value in either case. Then as the available volume delivered as shown in Fig. 2 is four times that in Fig. 1, a compressor of one-fourth the capacity, or, at equal piston speeds, with a cylinder of one-half the diameter, will be sufficient for the work. There will be no additional strength required in any of the working parts of the compressor; except that the cylinder must be strong enough for the higher pressure. The piping must be strong enough for the highest pressure employed and a return pipe and perfect connections must be maintained. A small pump attached to the compressor supplies the losses through leakage. As the same air is used over and over again it is soon drained of its moisture, and there is no possibility of freezing up, even if sufficiently low temperatures occurred, which they do not.

The air of Fig. 2, at 200 pounds pressure and 100 pounds back pressure, or at the higher pressures of Fig. 3, can be used with but little expansion. As the compression diagram suggests, the cut-off should never occur earlier than three-quarter stroke, so that the cut-off that may be accomplished by a good slide valve engine is all that would be available. In this respect the air of Fig. 1 has some advantage, as it, for the greatest economy, should be cut off at about one-quarter stroke, and a saving would be accomplished by the expansion which would not be possible where the higher pressures were maintained.

It seems to be quite clearly shown that in the line above indicated there is to be found a quite astonishing advance in the economical use of compressed air. I hope in the near future to show what has actually been done.

▲ ▲ ▲

Report of Commissioner of Patents.

The report of the Commissioner of Patents for the calendar year 1897 has been laid before Congress. The number of applications for patents, the largest ever received, was 45,661, and of patents issued 23,729. Patents expired, 12,926; expenditures, $1,122,843; excess of receipts over expenditures, $252,798; credit balance, $4,971,438. Connecticut still leads in the number of patents, with Massachusetts, District of Columbia, New Jersey, Rhode Island and New York following in the order named.

The business of the office is very much in arrears on account of the insufficiency of the office force. On December 28 there were 11,382 applications awaiting action. The report strongly recommends an increase of salaries of examiners. It also urges the establishment of a patent bar, and tells of the disbarment of several attorneys whose operations resembled confidence games.

The report speaks especially of the development of the bicycle industry since the inventions in pneumatic tires, about 1890. In 1895 more than 200 establishments were engaged in the manufacture with an output of 800,000 wheels. In 1897 more than 1,000,000 were made, the exports of cycles and parts to England alone being $2,128,421, and the total exports $6,902,736.

▲ ▲ ▲

Mr. Charles Churchill, managing director of Charles Churchill & Co., Limited, of London, will arrive in New York by the "Lucania" on April 2, and proposes spending some two months on this side, visiting the various manufacturers here they are representing. His headquarters will be in New York, at the offices of the American Gas Furnace Company, 23 John street.

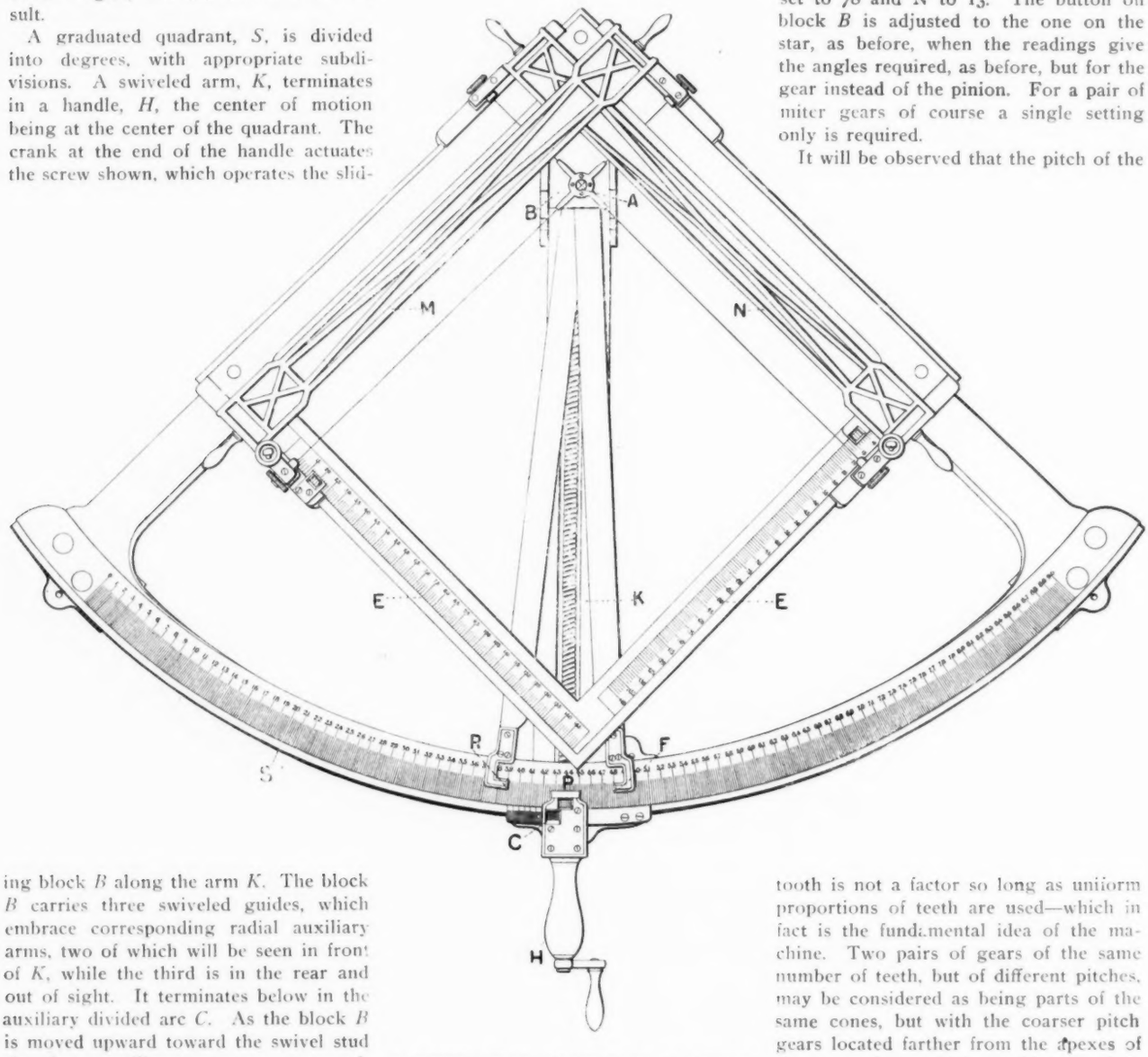
A Bevel Gear Computing Machine.

The accompanying illustration shows a very interesting machine or instrument for the determination of the various angles required in the construction of bevel gears. It is the design of Mr. James Gleason, of the Gleason Tool Company, Rochester, N. Y. As is well known, the Gleason Company does a large business in planing bevel gears to order, and the tiresome and laborious repetition of the calculations necessary to determine the various angles led Mr. Gleason to consider the advisability of making an apparatus for the graphical determination of the angles, and this device is the result.

A graduated quadrant, *S*, is divided into degrees, with appropriate subdivisions. A swiveled arm, *K*, terminates in a handle, *H*, the center of motion being at the center of the quadrant. The crank at the end of the handle actuates the screw shown, which operates the sliding block *B* along the arm *K*. The block *B* carries three swiveled guides, which embrace corresponding radial auxiliary arms, two of which will be seen in front of *K*, while the third is in the rear and out of sight. It terminates below in the auxiliary divided arc *C*. As the block *B* is moved upward toward the swivel stud the three auxiliary arms are separated, while as *B* is moved downward a reverse movement of the arms is made.

Slightly nearer the observer than the arms is the rectangular frame *E*, having edges which guide the two slides *M* and *N*. Each of these slides carries a strained wire, which passes freely through the arms of a star, *A*. The movements of the slides thus give corresponding movements to the star, which can thus be made to occupy any position within the rectangular frame. Accurately divided scales are mounted on two sides of the frame *E*, while the slides *M* and *N* have index marks for setting the slides to the divisions on the scales. These divisions are for the number of teeth in the two gears of a pair respectively, the range running from miter gears to those having a ratio of 10 to 1.

To illustrate the use of the machine, assume a pair of wheels having 13 and 78 teeth. Slide *M* is so placed that its index mark stands at division 13 on its scale, and slide *N* is placed at division 78 of its scale, star *A* moving to a position determined by these settings. Arm *K* is now swung about its center and block *B* is adjusted along the arm until a circular button on its front face is brought to match a corresponding button on the rear of the star. These buttons pass close to one another, and the adjustment is accurately made by matching them with the fingers.



A BEVEL GEAR COMPUTING MACHINE.

The settings are now complete, and locking the arm *K* in position the readings for the pinion can be taken off. Index mark *P* gives the pitch cone angle, *F* the face cone or blank angle, *R* the root cone or cut angle, and *C* the angle which the sides of a tooth make with one another, or the "caliper angle," as it is called in the Gleason shops.

For the 78 tooth gear the setting is repeated, but reversed, slide *M* being now set to 78 and N to 13. The button on block *B* is adjusted to the one on the star, as before, when the readings give the angles required, as before, but for the gear instead of the pinion. For a pair of miter gears of course a single setting only is required.

It will be observed that the pitch of the tooth is not a factor so long as uniform proportions of teeth are used—which in fact is the fundamental idea of the machine. Two pairs of gears of the same number of teeth, but of different pitches, may be considered as being parts of the same cones, but with the coarser pitch gears located farther from the apexes of the cones, from which consideration it is plain that the various angles will be the same in both sets.

The size of the machine and divisions of the scales are such that the angles can be read to within 1 minute of arc.

As used in the Gleason works, the machine is mounted permanently on the wall, where it can be consulted as de-

sired and as occasion arises. We judge from what we saw of it that its usefulness is quite up to its ingenuity—which is saying a good deal.

▲ ▲ ▲

Letters from Practical Men.

Bad Sand and Skin Drying.

Editor American Machinist:

The belief seems to prevail with many foundrymen that the quality of molding sand is a trivial consideration. In some foundries using unsuitable sand, the extra time necessary to make the molds and the high percentage of bad castings invariably resulting from its use amount to more than the total cost of suitable

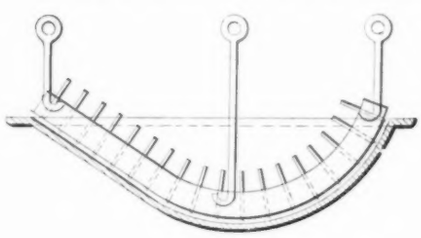


Fig. 1

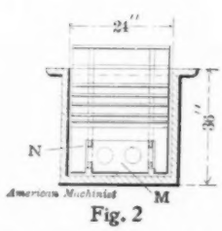


Fig. 2

MAKING CARCASS FOR WHEEL PIT MOLD.

sand. Observing molders who have had experience in different sections of the country have learned that there is a vast difference in the sands used for both the green and dry processes, and that a special treatment will produce good results with many grades, while some others are beyond any known treatment other than combination with other sands exceedingly rich in the elements required.

An engineer who would design an engine and select lead as a suitable material for the crank-shaft would at once be ridiculed, no matter how much he might discourse about the machinist not understanding the principles of alignment, the vibration of reciprocating parts or the properties of steam; failure in the performance of the engine would be charged where it belonged. But with the foundryman it is different. He may give a molder material as unsuitable for molding purposes as lead would be for a crank-shaft, and in explanation of the disastrous results following may prate about the ignorance and indifference of the molders, and the blame is thus not infrequently shifted from its rightful bearing.

Not long ago I had a disgusting experience in a foundry where the cheap sand and skin-drying folly obtained to a torturing extent. I will give a sketch of a comparatively light casting and the method by which it was made in that foundry, under direction of a foreman afflicted with the elaborate-rigging malady. Fig. 1 is a sectional view of a wheel pit casting and the cast iron carcass used. This carcass and the method and time used in its construction may merit more than passing notice; but I frankly confess to my inability to grasp any point worthy of imitation. From patterns made for the tie and straddle pieces *M* and *N*, in cross section Fig. 2, several pieces were separately cast; then into the mold for one of the curved girders several of the pieces *M* were set on end and the girder cast open; then while red-hot, yet strong enough to stand handling, the curved casting, with one end of the tie pieces cast in, was turned over and the other ends of the tie pieces set into a mold for the other curved girder, which, when cast open, completed the two girders, tied together about every 8 inches and ready for the straddle pieces *N*, which required some wedging to hold in place. Then this lifter was complete and ready for position in the mold. The process by which the complete carcass was made is about as expeditious as one of its type could be made, it requiring two molders and a helper but about one and a half days to make it, for lagging is something foreign to that shop. In something like one week the mold, after being very closely needle-wired and nicely dressed, was ready for the skin-drying; then all the men in the shop were regaled with the incense of burning wood, mingled with common zero atmosphere,

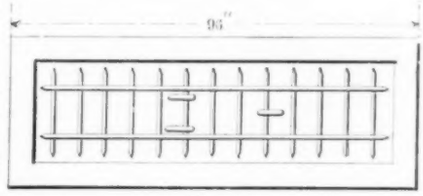


Fig. 4

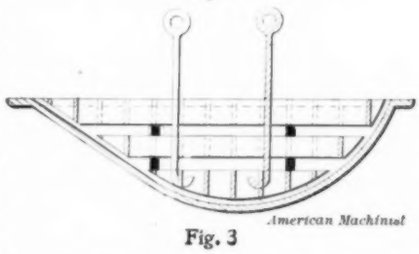


Fig. 3

MOLD FOR WHEEL PIT CASING.

admitted through doors and windows opened wide. After the necessary closing and securing, this piece of high art (?) work was cast about the time that many reputable citizens retire for slumber.

With anything like suitable sand, handled by two molders as capable as those men were, a perfect casting of such dimensions would be made in much less time in green sand; but when that casting came out scabs the size of a man's hand were not scarce upon it. Some might argue that they were the result of too hard ramming, improper venting or faulty slicking; but those grounds are untenable. Those molders well understood slicking wet blacking: as for hard ramming, it was not the cause, for there were scabs even at corners which showed strain, which was not due to the giving way of a flask, for it was made in the floor; and as for venting, it was a sight to see the cinders used, and the coarse and needle-wire venting on that mold! Those scabs were but the result of a lack of cohesiveness in the sand to withstand the penetrating effect of the molten metal.

Those who understand making sand lifters, with but a very little pattern, would make lifters for such a casting in a very few hours, and arrange them in the mold something like Figs. 3 and 4. The dimensions given are only estimated.

H. O'Neil.

▲ ▲ ▲

Graduation by Obliquity.

Editor American Machinist:

It is well enough to learn all that we can about the best ways and the most precise ways of doing things, and when we have learned all that we can in that direction jobs will still be coming along that will tax our natural and acquired abilities to the utmost. In other lines it is just as necessary to know how to do things quickly and cheaply and also tolerably correct, and if I try to talk a little of

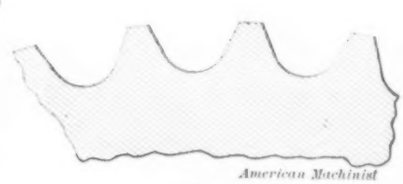


Fig. 1

FLUTES FOR SAW MILL ROLL.

this latter class of work, and if I don't tell a thing but what the best hands, and those that are thoroughly posted, know already, some of the young fellows and some of the older ones that don't know it all may be able to catch on.

One of the earliest jobs that I had in the shop was the fluting of feed rolls for saw mills. The rolls were of cast iron, probably the softest iron that I ever saw, but perfectly solid, or at least as solid in one spot as in another. They were about 8 inches in diameter and 3 or 4 feet long, with a journal on one end and a journal

and a place to key on a ratchet wheel on the other end. They used to turn the rolls whatever size they would finish to, never thinking of calipering them at all, and then they would come to the planer and me to be fluted. The flutes

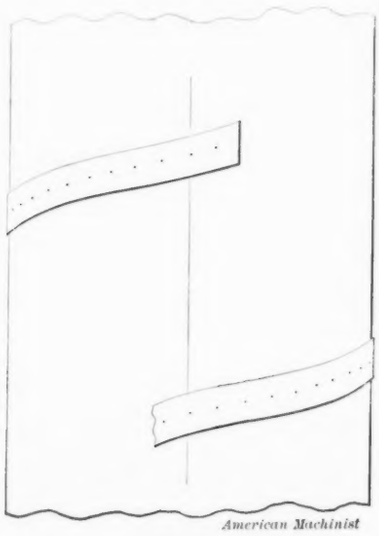


Fig. 2

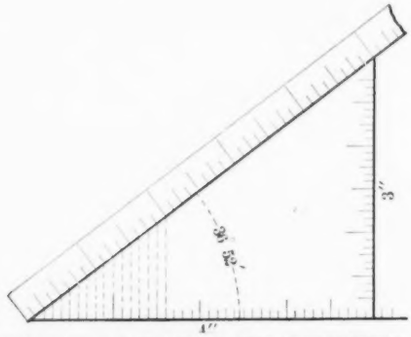
LAYING OUT THE FLUTES.

required were about like the sketch, Fig. 1, which I hope the engraver will make full size, as it will look more natural that way. They were left flat on the top about an eighth of an inch thick, and then I had to dig out the grooves about a half an inch wide between them. I used to plane each groove with about five strokes of the planer and leave a pretty smooth finish and nice, sharp corners. The rolls were planed on centers, but there were no means of graduation provided, and yet it would not do to work around without knowing how I was going to come out, as I would be just as likely as not to have a half a flute left at the end as any other way, and that would not do at all; so I always used to lay out the flutes before I began to plane.

Fig. 2 shows all there was of it. After the roll was on the centers I would mark a straight line on it and then I would take a strip of paper and wind it around the roll, sticking the ends of the paper to the roll, I blush to say it, not by glue or shellac, or mucilage, but by some of the black gum or grease that I was always able to scrape off the end of the on, as I have described, I would go around the roll with a prick punch and the job would be done. In planing, the prick punch mark was left in the middle of the rib.

Now that was a quick and cheap, and, as some would say, a rough and careless, way of laying out those flutes; but there was nothing rough about it, and the same principle is probably under certain conditions the best known way of making fine and accurate graduations. I have certainly used the oblique method of dividing straight or circular work into equal divisions, or into required numbers of equal divisions, a great many times and with a great deal of satisfaction and success.

We all know the three—four—five right angled triangle; that is, we all



EIGHTHS TO TENTHS AND TWELFTHS.

Fig. 3

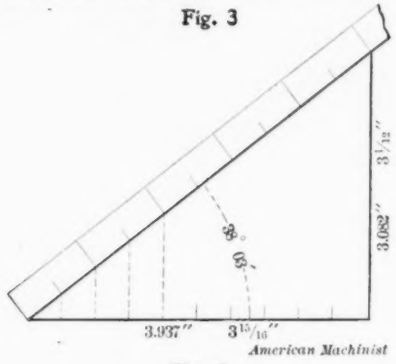


Fig. 4

HALF INCHES TO CENTIMETERS.

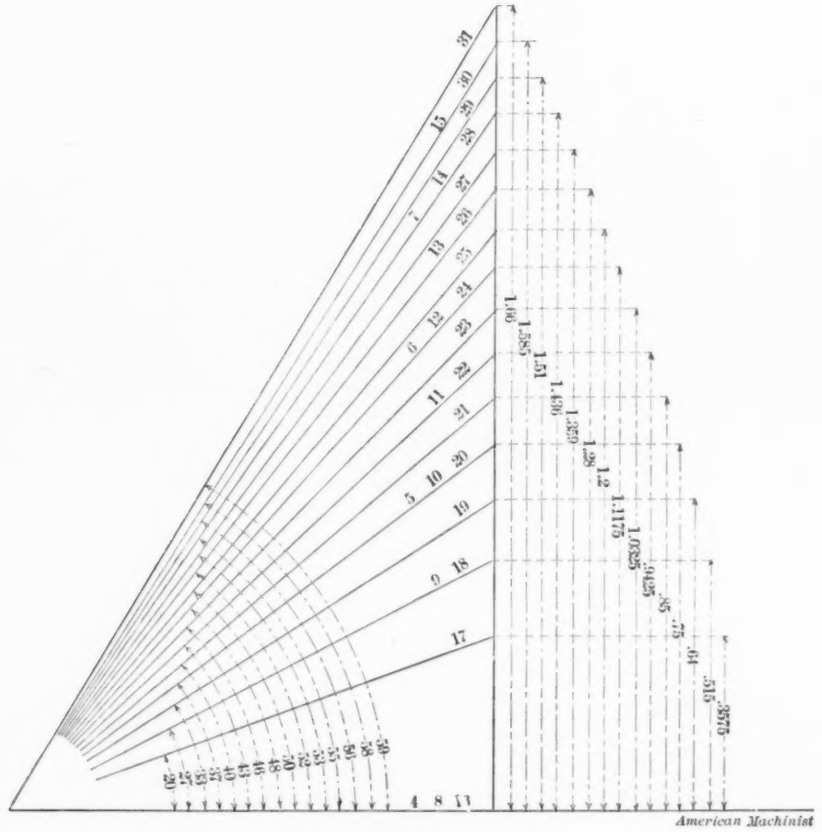


Fig. 5

FOR DIVIDING TO ANY NUMBER UP TO 31.

ways. Those were the days of whale oil. I am sorry that I have not got the job just now, as I would like to try chewing gum for sticking the paper, but I certainly never thought of it then. Those strips of paper I used to keep all ready divided with the central marks 5/8 of an inch apart and each strip longer than enough to reach around the roll. When I laid the strip around square the spots would hardly ever come together, and then I would slant it, or wind it helically, as shown, until the marks would come on the line. When the paper was stuck

know that in a triangle having sides in those ratios one angle is a right angle, and it is the simplest way ever found for getting a right angle. Perhaps everyone has not caught on to the neat way that this triangle lends itself to dividing lines, as we often want to, into tenths or twelfths. Fig. 3 talks for itself. If you have eighths on the hypothenuse, or five unit side, by drawing perpendiculars to them you get tenths on the four unit side and twelfths on the three unit side.

If you happen to want metrical measures you can always get them as shown

in Fig. 4. Draw the two sides that form the right angle to the lengths given and their perpendiculars drawn to half inch marks on the hypothenuse will give centimeters on the base. It will be simpler and easier remembered to make the base 4 inches and the perpendicular 3⅛ inches. The pitch of the hypothenuse may be got by the angle, as indicated, without measuring the lengths of any of the lines.

Fig. 5 shows the hight of the vertical, and the angle, for getting any number of divisions less than 32. Say that we want nineteenths; if we have sixteenths on the third hypothenuse, marked 19, perpendiculars drawn to those sixteenths will give nineteenths on the base, and so on. When we have the correct angle for the hypothenuse we are, of course, not limited to the triangle, but may follow the same system outside of it as far as our rule or board extends. The angles in Fig. 5 are, of course, not quite correct, but as nearly so as they can be given, using degrees only. As I said at the start, I had no idea of telling anything new at all; but I know I have called attention to a line of practice that it is handy to keep in mind and that some fellows miss.

TECUMSEH SWIFT.

▲ ▲ ▲

A Special Automatic Machine.

The half-tones herewith show a new automatic milling, drilling and tapping machine made by the Mossberg & Granville Manufacturing Company, Providence, R. I. It has been specially designed for doing the machine work on battery zincs, but may be employed for any class of work requiring similar operations. The stock operated upon is ⅜-inch square, the work being done upon one end of the pieces, which are fed to the machine by a boy. The machine mills the end of the bar round for a length of 1¾ inch, drills and taps a hole in the end for a screw, and drills a cross hole for a pin. The cylindrical chuck has six clamping jaws for holding the bars, and is moved intermittently and quickly one-sixth of a revolution at a time. While the chuck is at rest the various machining operations go on simultaneously, four ends being operated upon each time the chuck stops. The bars are ejected automatically. The chuck cylinder is rotated by a segment of a gear on an index shaft engaging a gear connected with the cylinder, and the cylinder is locked when it stops. The spindles carrying the various tools are fed up to their work by cams having a quick return and a period of rest. The tap shaft is positively driven by gearing driven by a rack, which also is operated by a cam. All the movements of the machine are synchronized from the shaft which carries the cams. All operations are adjustable as required. The bars are finished at the rate of 200 to 300 per hour, according to the speed at which the machine is driven. Fig. 1 shows the front end and side of the machine, with the clamping movements of the chuck, also the drill spindle for the cross hole, the driving pulley of which is at the extreme right. Fig. 2 shows the other side. It will be noticed that a plentiful supply of oil is provided for.

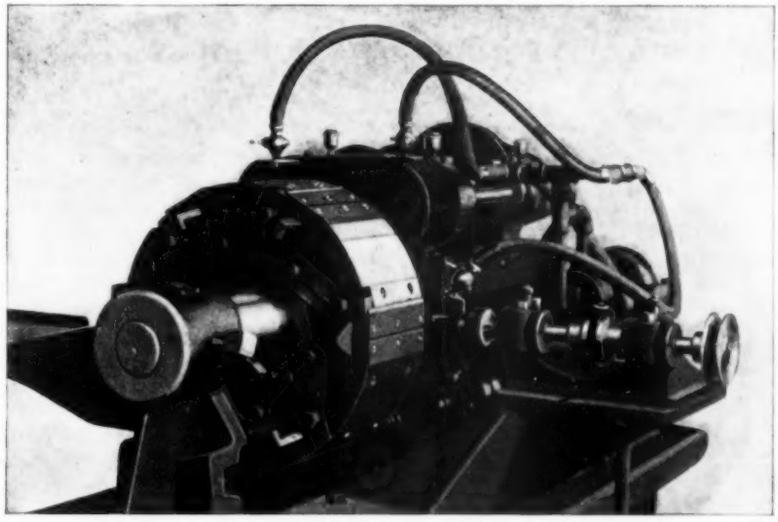


FIG. 1.—A SPECIAL MILLING AND THREADING MACHINE.

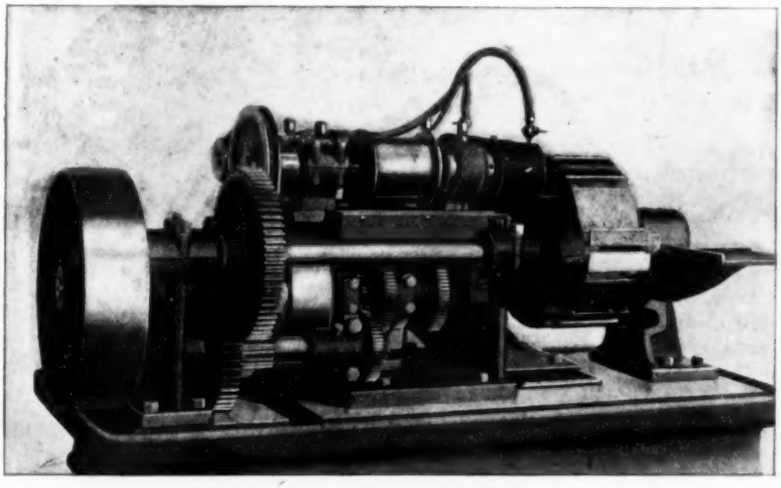


FIG. 2.—BACK OF MACHINE.

▲ ▲ ▲

A School's New Equipment.

The Alabama Polytechnic Institute, Auburn, Ala., is installing in its new mechanical engineering laboratory a small steam plant to be used for the purposes of instruction and experimentation. A pair of "Imperial" engines, with cylinders 7x8 inches and 12x8 inches, are so placed that they may be coupled together and run as a cross-compound, or disconnected and operated separately as simple engines.

The auxiliary apparatus consists of a Wheeler surface condenser, a Deane (of Holyoke) vacuum pump and a duplex circulating pump of the same make. Indicators, steam calorimeters, thermometers and other necessary appliances for making tests are already at hand. The power will be absorbed by a Prony brake.

The laboratory is already equipped with a Riehlé testing machine with micrometer extensometer, a coal calorimeter with auxiliary apparatus, a gasolene engine, gage testing apparatus and a number of sectional models, intended to illustrate manufacturing products and processes. Four other engines installed in other departments of the institute, together with well-equipped wood shop, machine shop, foundry and blacksmith shop, offer unusual facilities for engineering investigation.

▲ ▲ ▲

There is said to be an 8-foot vein of excellent coal within 16 miles of Detroit, Mich.

AMERICAN MACHINIST

Published Thursdays by

American Machinist Publishing Co.,

256 Broadway, New York.

JOHN A. HILL, President and Treasurer.

C. A. HANSMANN, Sec'y.

Editorial Department.

FRED J. MILLER, Chief.

FRANK RICHARDS,
F. A. HALSEY,
EDWARD P. BUFFET, } Associate Editors.

Illustration Department.

A. L. DONNELL, Chief.

Advertising Department.

C. P. DAY, Eastern Representative.

J. M. WAKEMAN, Western Representative.

Foreign Agents:

R. E. HOWARD,
10 Finsbury Square, London, E. C.,
Representative for Great Britain.

FENWICK FRERES & CO.,
21 Rue Martel, Paris,
Representative for France, Belgium,
Switzerland and Italy.

WEEKS & JOHNSON,
Lovedoy St., Johannesburg,
Transvaal Republic,
Representative for South Africa.

Space in advertising pages only is for sale.
We invite correspondence on subjects pertaining to machinery.
Name and address must always be given, though not necessarily published.
Communications for or relating to the reading columns should be addressed to the Editor. All business communications should be addressed to the Company.
Subscribers can have their mailing address changed as often as they desire. Send both old and new addresses. Those who fail to receive their papers promptly will please notify us at once. Date on wrapper denotes week with which subscription expires.

Subscription Price:

$3.00 a year in advance, postage prepaid in the United States, Canada and Mexico.

$4.00 a year to other countries, postage prepaid.

Entered at Post Office, New York, as second-class mail matter.

For Sale by Newsdealers, Everywhere.

No back numbers beyond 1897.

▲ ▲ ▲

The Death of Bessemer.

Sir Henry Bessemer, F. R. S., Hon. M. Inst. C. E., Hon. M. A. S. M. E., etc., died in London on March 14. He was born at Charlton, Hertfordshire, England, in 1813. He was an inventor from the first, and early had command of the means for developing and pushing his inventions. While the Crimean War was in progress he was engaged in experiments with projectiles for the guns of that period. At the suggestion of the inventor of the Minnie rifle his attention was turned to the need of a better material than cast iron for artillery, and his efforts were at once absorbed in systematic investigations and experiments in this line. The process of decarbonizing iron by blowing air through the molten metal was only arrived at after various experiments with furnaces under a wide variety of conditions, and the construction and operation of the converter also went through a process of development. In 1856 Mr. Bessemer blew a charge of seven hundredweight of pig iron into an ingot of malleable iron or mild steel, and the same year he read a memorable paper at the Cheltenham meeting of the British Association. The paper made a sensation at once, and within a month Mr. Bessemer received $135,000 for licenses to use the new process. It was, however, at this stage not a complete success, the product being uncertain and unmerchantable. The use of spiegeleisen for recarbonizing and deoxidizing after the blow, which had been invented by Mr. Mushet, made the invention a complete practical success.

As A. L. Holley said, the Bessemer invention was as much a mechanical as a chemical one. The process in its entirety is not merely the burning out of the carbon by the blast of air, and, as perfected, the subsequent addition of a carefully determined proportion of carboniferous material, but it is also the quick and easy manipulation of great masses of molten metal. To the complete success of Bessemer's work the business faculty, as well as that of the inventor pure and simple, was necessary, and the persevering force or personal momentum to carry him through or over every obstacle. All that was thus needed seems to have been marvelously combined in the man. It may be charitably assumed that the force which carried him to success was also that which carried him a little beyond a just and equitable acknowledgment of his indebtedness to his contemporaries. While his experiments were going on, and his processes and apparatus were developing, he was not the only one at work on the cheap steel problem. He may not have known all that others were doing, and at many points where anticipated he may still have been an independent inventor. As to some details it seems to be clear that he was indebted to, if indeed his process was not saved by, others. To at least Kelly and Siemens and Mushet he could easily have conceded every iota that was due them without diminishing his own fame. Bessemer may perhaps be considered the most successful, or the fullest rewarded, inventor known to history. The Bessemer process is of untold value to the human race, and most revolutionary in its stimulus to universal progress, and his name is as indissolubly attached to it as is that of Amerigo Vespucci to the discovery of America. The value of the invention has been recognized by all the world. Wealth beyond the ability of the individual to enjoy was poured into his lap, titles and honors from learned societies and national governments were showered upon him, and he lived many years to enjoy his rewards. His success stands as a distinct encouragement to those who see other great opportunities.

Questions and Answers.

Name and address of writer must accompany every question. Questions must pertain to our specialties and be of general interest. We cannot undertake to answer questions by mail.

(26) A. B. & Co. ask: Would you give us the formula for making a rust joint with cast-iron borings that will stand steam heat. A.—Rust steam joints are usually made with sifted cast-iron borings or turnings, sal-ammoniac and a little sulphur, mixed to a rather stiff paste with water, and packed into the joint with a chisel or calking tool. One part sal-ammoniac, two of flowers of sulphur and eighty of iron borings or turnings, by weight, is given for quick setting, and one sal-ammoniac, one-half sulphur and 100 of iron for slow setting.

(27) F. W. S., Burlington, Ia., asks: Can you refer me to books giving the latest and best practical methods of chemical analysis for iron and steel castings and the alloys? A.—We believe there are no books which will be apt to meet your requirements. The only way, we think, to become a competent analytical chemist for such work is to take a course in analytical chemistry, and after that devote your entire time to that particular branch of the work. Analyses made by those who have not thus prepared themselves are not likely to be of much value.

(28) J. L., New Holstein, Wis., asks: How does a dynamo generate current to energize its field magnets when starting? Without a flow of electricity through the field coils there is no magnetism, and without magnetism the dynamo will not generate electricity. A.—Iron which has once been magnetized retains a small amount of magnetism, called residual magnetism, after the magnetizing influence has been withdrawn. This residual magnetism is sufficient to generate a small current which immediately strengthens the magnetism, and this in turn strengthens the current, and in this way the full power of the machine is reached. While the action is successive in this way, it is all done so quickly as to be almost instantaneous. This explanation shows why a machine that has once been operated should start itself again. When the magnetic influences in an electrical works are considered it will be seen that the magnets of dynamos can hardly fail to receive some magnetism in the process of manufacture, and they do, in fact, become thus sufficiently magnetized—with rare exceptions—to start themselves the first time they are put in motion.

(29) D. S., Chicago, has an air compressor, operated by a gasolene engine, in an Arizona mine, where water is very scarce, and it is necessary to use the water over and over again in the jackets of engine and air cylinders. The air drills run but part of the time. He desires to know if it would be possible to utilize the compressed air from the plant for cooling the water, and if so, what device would be suitable for this purpose. The water is stored in wooden tanks. A.—It would not be advisable to attempt to cool the water by an air jet, as recent articles in our columns have shown. If you have a small engine in use near the compressor it might be advisable to operate it with air and then use the exhaust to cool the water by carrying it through a nest of pipes submerged in the water tanks. Before attempting to put such a

plan into use, however, we would advise you to investigate the water-cooling towers which have been noticed in our columns, and which are used to cool the condensing water from steam engines so that it may be used over and over. We can see no reason why this process should not be equally applicable to your case. We may add that we have known compressors, in cases of restricted water supply, to be run without water in the jackets. The air cylinder gets pretty hot, but no harm comes from it. For your gasolene engine you, of course, require water.

▲ ▲ ▲

An Impostor.

Charles Churchill, of London, writes us as follows: I have just heard from two or three sources that some one calling himself Gordon Churchill and claiming to be my son is traveling in the Eastern States and using my name to swindle our friends there. This man is an impostor, entirely unknown to me. My three sons are all with me, and have been for many months past in London. This information may prevent some of our other friends being imposed upon by him.

▲ ▲ ▲

Too late to use in connection with our reply to the Brown & Sharpe Manufacturing Company's letter, published elsewhere in this issue, the news comes that Colonel Mordecai has already stirred up trouble at Watervliet Arsenal and that a strike is threatened there on account of his arbitrary actions and attempts to introduce military methods in machine shop management.

▲ ▲ ▲

It is announced that by an imperial ukase orders have been issued by which the Russian Government will spend 90,000,000 rubles in the construction of naval vessels, and this should have a direct effect upon the machine tool trade in Russia. It is announced also that England's expenditure on account of the navy may be in the near future very largely increased, possibly as a result of the announcement of Russia's policy.

▲ ▲ ▲

The "Statist," of London, has recently printed an article in which it states that the exports and the home consumption of iron have exceeded the whole output of the United Kingdom by nearly half a million tons, and it predicts a pig iron famine before the end of the present year, stating that Great Britain may have to fall back upon America at no distant date to make good its deficient supply.

▲ ▲ ▲

It seems likely that those machinery building establishments which are fitted to construct gun carriages may have all they can do in the near future, as it is stated that all of such establishments which have recently put in bids for the construction of gun carriages have been asked to state how soon they might be able to supply them if demanded.

▲ ▲ ▲

It is announced that wages of employés at the Rock Island Arsenal have been restored to the rates existing previously to December 31, 1897. A reduction of wages made at that time has caused considerable commotion and agitation, with the result of the restoration noted above.

▲ ▲ ▲

The Royal Administration of the Swedish State Railways invites a competition of designs for the arrangement of new railroad stations, junctions, etc., for the city of Stockholm. The first prize is to be $3,230, the second $2,150 and the third $1,075.

▲ ▲ ▲

John Needham & Sons, of Manchester, England, have concluded, partly as a result of a recent tour in this country of Mr. John Needham, to open a house in London to engage largely in handling American products, especially in the line of hardware and machinery.

▲ ▲ ▲

A prominent feature of the business situation continues to be the organization of trusts and combines of various kinds, two of the latest being one for the control of Bessemer pig iron and the other of bridge building.

▲ ▲ ▲

Warner & Swasy, Cleveland, Ohio, are filling a large order for the Government for telescopes, to be used on heavy guns. They are also at work on a model of a new range finder.

▲ ▲ ▲

Personals.

Assistant Engineer R. K. Crank, U. S. N., has been ordered to the Norfolk Navy Yard.

Chief Engineer W. H. Nauman, U. S. N., has been detached from the "Monadnock" and ordered home.

B. M. W. Hanson has been appointed assistant superintendent of the Pratt & Whitney Company's small tool department.

Assistant Engineer E. S. Kellogg, U. S. N., has been detached from the "Machias" and ordered to the New York Navy Yard.

Passed Assistant Engineer T. W. Kinkaid, U. S. N., has been detached from the "Terror" and ordered to the "Machias."

Chief Engineer W. B Dunning, U. S. N., will be detached from the "Monadnock," on the arrival of that vessel at San Francisco.

Passed Assistant Engineer D. E. Dismukes, U. S. N., has been detached from the Norfolk Navy Yard and ordered to the "Terror."

Mr. Frank Farmer, of the Cleveland Machine Screw Company, has recently taken charge of the die-making department of the Toledo Machine Tool Company, of Toledo, Ohio, filling the vacancy left by Mr. Aug. Skareen.

Chief Engineer C. J. Habighurst, U. S. N., has been detached from the "Richmond" and ordered to the Columbian Iron Works.

Passed Assistant Engineer B. C. Bryan, U. S. N., has been detached from the Bureau of Steam Engineering and ordered to the "Dolphin."

Passed Assistant Engineer H. Page, U. S. N., has been detached from the Union Iron Works and ordered to the Wolff & Zwicker Works.

Chief Engineer R. W. Galt, U. S. N., has been detached from the Wolff & Zwicker Works, Portland, and ordered to duty with the "Charleston."

Chief Engineer A. C. Engard, U. S. N., has been detached from the Columbian Iron Works, Baltimore, and ordered to Mare Island with the "Philadelphia."

Chief Engineer J. K. Barton, U. S. N., has been ordered to the "Richmond," and will continue his duties as member and recorder of the Naval Engineers' Examining Board.

Mr. E. A. Rainous, formerly with the Harvey Hubble Company, manufacturer of machinery and tools, of Bridgeport, Conn., has accepted a position as foreman with the Mountain Electric Company, of Denver, Col.

▲ ▲ ▲

Commercial Review.

NEW YORK, Saturday Evening, March 19, 1898.

THE MACHINE TOOL MARKET.

It seems like uttering a mere truism to say that the demand for machine tools in certain quarters has been greatly stimulated by the activity in military supply construction following the destruction of the "Maine." It appears that steam engines and electrical machinery have suffered from the public furore; but machine tools occupy a peculiar position, and, although they may have suffered in some respects, they have been benefited in others.

The national ferment has not had precisely the same effect upon the business of any two machine tool concerns that we have consulted. In general, it may be said that while regular inquiry has been retarded somewhat, a rush of orders, more or less directly connected with Governmental work, has come to many companies building a line of tools adapted to projectile manufacture and allied purposes. And, indeed, it may be affirmed that in numerous machine tool establishments there is, at present, a miniature boom.

"We now have our regular trade and the military demand in addition," says a local seller. Another speaks of present conditions in terms of the highest optimism, and his words weigh the more from the fact that he is a man of calmly judi-

cial temperament. He believes that we have entered an era almost of boom, which, he says, he has for some time seen coming, having noticed the similarity of present conditions to those existing in the year 1879; for instance, in respect to heavy exports. The excellent demand existing this month he finds in great measure to be owing indirectly to war preparations.

On the other hand, a large company, which has not been doing much in the way of military work, excepting sending some torpedoes to the Cubans on an order taken before the "Maine" disaster, noticed in the two weeks following that event a marked falling off of inquiry; the thickness of the day's mail diminishing from 4 inches to 1 inch, roughly speaking. Subsequently, some recovery has been noticed.

Among the Government contractors who lately have been buying tools are the United States Projectile Company, which has placed orders with several parties locally represented. Another instance is the Driggs-Seabury Gun & Ammunition Company, Derby, Conn., which has bought two carloads of machinery from the Niles Tools Works agency, New York.

The Niles Tool Works, Hamilton, Ohio, are now working nights, and they have recently started operations in an extra building, across the street from their main works, and which they have not made use of for several years. There they propose to manufacture interchangeable parts for certain of their tools.

We hear indirectly from a large Eastern tool manufactory that it has been supplying tools for purposes connected with war preparations for several months past; the Government having, it is said, foreseen the approach of a crisis in our foreign relations, and quietly been preparing for it before the attention of the country was abruptly aroused by the "Maine" disaster.

The demand for machinery caused by the spurt in ordnance manufacture is not as gratifying to manufacturers as would be the same amount of business coming through other channels. A New England machine tool builder spoke yesterday in deprecating terms of the whole matter, and lamented the fact that he was unfortunate enough to have had a stock of tools on hand just adapted to the requirements of Government contractors, who snapped them up, instead of leaving them to be disposed of, in due course, to ordinary purchasers.

All in all, respective and irrespective of the military demand, a word that now may with propriety be used in connection with machine tool manufacture is "activity." Those in a position to know cite off-hand the names of plenty of out-of-town concerns that are "very busy." Here is a batch of five, not mentioned by us very recently, and of whom that statement is made: Draper Machine Tool Company, Long & Allstatter Company, Morgan Engineering Company, Prentiss Brothers, F. E. Reed Company. The city of Cincinnati, Ohio, is said to be a bee-hive of industry at present. Worcester, Mass., is also active, and Fitchburg, Mass., comparatively so.

BELTING.

The Chicago Belting Company informs us that its business shows an increase of 75 per cent. over last year. It has just sold complete belting equipments for two flour mills, besides supplying three sawmills, a cotton-seed oil mill in Mexico,

Continued on page 35.

▲ ▲ ▲

Business Specials.

Gear wheels, gear cutting. Grant; see page 16.

Power hammers, Jenkins & Lingle, Bellefonte, Pa.

Forming Lathes. Mer. Mach. Tool Co., Meriden, Conn.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N. Y.

Stationary—Rights of two valuable engine patents, both for $1,000 if taken at once; great bargain. Geo. Wolf, 215 Birch Street, Cleveland, Ohio.

Wants.

Situations and Help Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Situations Wanted

Experienced mech. draftsman. Box 145, AM. MACH.

A first-class pattern maker and draftsman desires a situation; A1 references, Box 155, AM. MACHINIST.

Mechanical draftsman, tech. grad., 6 yrs' exp. gen. and elect. mach. desires per. pos. Box 144, AM. MACH.

Mach., eng., dsgnr., d'ftsm'n; pumping mach., engs., etc., open for engagement. Box 164, AM. MACHINIST.

Wanted situation by blacksmith, good forger steel or iron; also wagon work. Box 141, AMERICAN MACHINIST.

Wanted—Pos. as supt. of generating and transmitting power; large plant pref. Box 159, AM. MACHINIST.

Position by triphammer forger; all kinds forging and welding; fair blacksmith; good reference. Box 158, AMERICAN MACHINIST.

Wanted—A position as foreman pattern maker, or permanent position at the bench, by middle-aged experienced man. Box 160, AMERICAN MACHINIST.

A shop superintendent of one of the most successful turret lathe builders desires a change; nine years' in present position; best ref. Box 130, AM. MACHINIST.

Mechanical engineer, graduate from German college, experienced, from the practical work in shop to superintendence and management of manuf'g, open for engagement as supt. or chief engineer. Box 154, AM. MACH.

Foreman smith, first-class worker, loco., marine or stationary, 12 years' last two places, wants a change; good reference for handling men and getting work out cheaply with dies, formers, etc. Box 162, AM. MACH.

Man (29), energetic, speaks French and some Spanish; seven years' experience as salesman, is machinist and draftsman, wants position as salesman, U.S. or abroad; well con. in London and Paris; refs. Box 151, AM. MACH.

Brass foundry foreman wants situation; understands all details in running shop, mixing metals from old and new stock, and a good manager of help; first-class references. Box 163, AMERICAN MACHINIST.

Position wanted by young man, 32 years old, graduate of Stevens Inst., 6 years' exp. in management of iron foundry; will act as agent for firm, go on road or fill position in office. Box 168, AMERICAN MACHINIST.

An energetic, throughly practical foreman of tool and mfg. dept., has had a successful experience as foreman on guns, sewing mach., bicycle and typewriter, wishes to make a change with a progressive firm; ref. furnished of present and past empl. Box 157, AM. MACH.

A good mech. draftsman wishes position. Address, G. W., care of A. Warth, No. 40 Second St., N. Y. City.

A practical M. E. of 15 years' experience wants position as supt. of machine shop; best references. Address, Box 166, AMERICAN MACHINIST.

Thorough machinist, with tech. education and extensive exp., wants position as superintendent or designer on metal-working mach. Box 161, AM. MACH.

D'ftsm'n, mech., with 10 yrs. prac. exp., wants pos.; convs. with engs., boilers, hoist, conveying and gen. mach. No object. to go anywhere. Box 167, AM. MACH.

Help Wanted.

Wanted pattern tender; one used to foundry and patterns; steady position. Address, Box 134, AM. MACH.

Wanted—One or two strictly first-class blacksmiths for heavy work. Apply The Bucyrus Company, South Milwaukee, Wisconsin.

Wanted—First-class draftsman, one who has had experience on traveling crane work preferred. Box 135, AMERICAN MACHINIST.

Wanted immediately 10 first-class machinists, both floor and machine hands. Apply, The Bucyrus Company, South Milwaukee, Wisconsin.

Wanted, draftsman with thorough experience in machine tools and automatic machinery of hopper feed class. Box 140, AMERICAN MACHINIST.

Wanted—An experienced man to take charge of machine shop employing fifty men, doing general job work; liberal salary. Address, Box 150, AM. MACH.

Wanted—A first-class mechanical engineer competent as designer and supt. on heavy hoisting, dredging and marine machinery. Address Box 153, AM. MACHINIST.

Wanted—A leading draftsman on heavy hoisting hydraulic and general machinery; must have at least 10 years' experience and competent to take charge of work. Address Box 152, AMERICAN MACHINIST.

Wanted—A machinist or molder with one to three thousand dollars, to invest in a long established foundry business in a large Eastern city; good position and income from investment assured to the right party. Box 156, AMERICAN MACHINIST.

Wanted—A first-class practical machinist and draftsman for a manufactory near New York, who has worked years at the trade and can make a fair drawing; a man of an inventive turn desired. Address, giving full particulars, P. O. Box 2324, New York City.

Wanted—A thoroughly competent man to take charge of the armature and field winding department of one of the leading electrical companies; with application state experience, what wages would be exp. and also if now eng. in this work. Box 139, AM. MACH.

Wanted by an established concern a machinist, molder and pattern maker who can together raise $5,000; must be first-class men, competent to take charge of their respective departments; dividend guaranteed; none but first-class men of sober and steady habits need make application; work in general mill and mining machinery. Ad. Opportunity, AM. MACH.

Miscellaneous Wants.

Advertisements will be inserted under this head at 30 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Wanted—Lathe and planer. 7 Quay street, Buffalo.

Book, Dies & Die Making, $1. J. L. Lucas, Prov. R. I.

For selling or buying tools apply J. Klein, South Parade, Manchester, England.

Machine shop wanted by competent parties. Address Engineer, Box 571, Pittsburg, Pa.

The Dutton Wet Twist Drill-Grinder is sold by the Garvin Machine Co., New York City.

Emery Wheel Dressers; send for sample and price. Manufactured by Geo. H. Calder, Lancaster, Pa.

For Sale—Second-hand drill presses, engine lathes and planers. Dietz, Schumacher & Boye, Cincinnati, O.

Best and cheapest Bolt Header, made by Baush & Harris Machine Tool Co., Springfield, Mass.

Light and fine mach'y to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

For Sale—Several lathes and drill presses nearly new at very low figures for cash Wallace H. Mansfield, New Haven, Conn.

Wanted interest in mfg. or foundry business to the amount of about $6,000. Address with particulars Partner, care AMERICAN MACHINIST.

Wanted—Newest catalogs with lowest prices of all kinds of tool mach., chucks and fine tools for wholesale. Schroder & Stein, Berlin 19, Ger., mach. and tool mchts.

Wanted—By an established business, two first-class mechanics, with from $2,000 to $3,000 each, to form stock company; object, to enlarge business. Address, Box 165, AMERICAN MACHINIST.

Miscellaneous Wants—Cont'd.

Machinery dealers wanted as agents in New York, Boston and Philadelphia to handle our automatic engines, etc. Clark Bros., Belmont, N. Y.

For Sale—New five-keyed combination cash drawer lock, with complete patterns, jigs, tools, etc., for manufacturing same. C. H. Shaffer, Muskegon, Mich.

Wanted complete equipment of machine shop tools, including lathes, planers, drill presses and boring machines. Address F. C. Austin Mfg. Co., Chicago, Ill.

Lathes, planers, drills, milling machines, vises, also brass working machinery second-hand; must be modern and in first-class condition. C. C. Wormer Machinery Co., Detroit, Mich.

The advertising department of the American Machinist has on hand 20,000 draftsman's thumb tacks; will send a box of ten to any draftsman in America on request; could use a postage stamp on box, but will send the tacks anyway.

For Sale—A well established motor and dynamo mfg. business; steady trade with some of the best houses in the country; several valuable patents; special labor saving machinery designed and made for our own work; will dispose of machinery and tools, finished and unfinished dynamos, patterns, wire, etc.; building and water-power to be included or not, at option of purchaser; satisfactory reason for selling; cash price, $15,000. Address Dynamo, care of AMERICAN MACHINIST.

Brains and hands do their best work in the field of their experience. The Century Machine Co., 576 West Broadway, New York, employs trained brains and trained hands in the persons of mechanical experts who are competent to solve intricate mechanical problems and make operative models. The designing of automatic and labor saving machinery is in charge of Mr. Oluf Tyberg and assistants. The Century Machine Co. is equipped with most modern tools as well as men. Light machine work, experimental work, model making and manufacturing solicited.

HYDRAULIC RIVETERS, FIXED and PORTABLE Types,
For Every Variety of Work. All numbers and sizes.
HYDRAULIC CRANES, Hydraulic Flanging and Forging Presses.
STEAM HAMMERS.
CHAMBERSBURG ENGINEERING CO.,
Main Office and Works, Chambersburg, Pa.
Pittsburg Agts.: Manning, Maxwell & Moore, Telephone Bldg.

Mechanical Drawing.

Introductory Course in Mechanical Drawing. By JOHN C. TRACY, C.E., Instructor in the Sheffield Scientific School of Yale University, with Chapter on Perspective, by E. H. LOCKWOOD, M.E. With Illustrations including Reproductions of Photographs of Models. Oblong 4to. Cloth, $1.80; by mail, $2.00.

This work is strictly an *introductory* course, embracing the ground which a student should cover before taking up certain lines of drafting, such as Machine Drawing and Bridge Drawing. The titles of the chapters indicate the ground covered: The Selection of the Outfit, The Use of the Drawing Instruments, Working Knowledge, Isometric and Cabinet Projection, Orthographic Projection, Special Applications of Orthographic Projection, Perspective and Working Drawings. The author's experience with large classes has acquainted him with the needs of the beginner, and in the chapters on The Use of the Drawing Instruments and Working Knowledge he has brought together numerous hints and suggestions. The completeness of these chapters is a feature of the book which makes it especially adapted for use by students working without the aid of a teacher, or in large classes.

Descriptive Circular on application.

Address HARPER & BROTHERS,
Franklin Square, New York City.

For Advertisement of
TIGHT JOINT CO., New York.
See Issue March 3, 1898.

THE CROSS OIL FILTER

actually reduces oil bills 50% or more. Sent on approval. Used in 17 countries. Testimonials from leading firms in every field of industry.

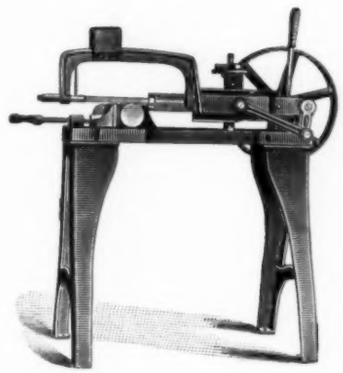
Business established eight years.

THE BURT MFG. CO.
AKRON, O., U. S. A.

Largest Manufacturers of Oil Filters in the World.

"The best is as good as any."

The New
Automatic and Gravity Feed
Q & C Shop Saw

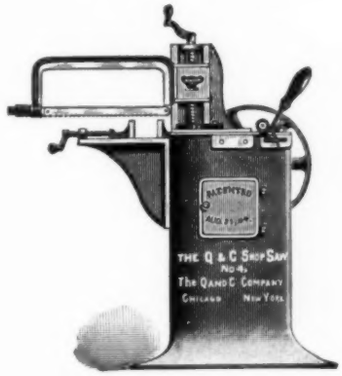


Cuts { Tool Steel, Machinery Steel, Iron, Brass and All Other Metals.

Price—'Way Down.
Quality—'Way Up.

Shop Saws,
Portable Rail Saws,
Cold Power Saws,

For All Purposes.



Send for Catalogue.

Q & C Company,

Chicago. New York.

LONDON: Chas. Churchill & Co.
PARIS: Hounsfield & Fils.
BERLIN: Schuchardt & Schutte.
MADRID: J. G. Neville & Co.

Continued from page 34.

etc. A late order is for a 3-ply belt 5 feet wide.

LOCOMOTIVES FOR EXPORT.

Two sizeable orders for locomotives to go abroad have just come to American manufacturers. One is from the Kiushiu Railroad of Japan to the Schenectady Locomotive Works for twelve engines, and is a duplicate of an order executed last fall. These locomotives are of 16x24-inch cylinders, and the gage 3 feet 6 inches. The Baldwin Locomotive Works, Philadelphia, have taken a contract to furnish fifteen heavy mogul freight engines to the Egyptian State Railway. Not all the locomotive orders are coming this way, however, for the Eastern & China Railway Company has placed a contract for eighty locomotives with the Fives-Lille Company, of Paris, and it is said that there is more to follow in the same direction. The United States may hope to do some business with Russia this year, for the Russian Government is said to have set aside $10,000,000 for the purchase of locomotives for the Russian State Railroads during 1898. The Russian works, which have an annual capacity of not more than 1,000 per annum, are already filled with orders; so more or less will have to be ordered abroad. In addition to the engines needed for the State roads, it was said that some would be purchased early this year for the Siberian railway. H. K. Porter & Co., of Pittsburg, have taken a contract for locomotives for a Russian suburban railroad after a sharp competition with German manufacturers. It is stated that Mr. G. A. Hansen, of Denmark, is writing to this country for information about rolling stock, and early next summer will make a personal investigation here with a view to buying cars and locomotives.

▲ ▲ ▲

Quotations.

NEW YORK, Monday, March 21.

Iron—American pig, tidewater delivery:

No. 1 foundry, Northern	$11 00 @ 11 50
No. 2 foundry, Northern	10 50 @ 11 00
No. 2 plain, Northern	10 00 @ 10 50
Gray forge, Northern	10 00 @ 10 50
No. 1 foundry, Southern	10 75 @ 11 00
No. 2 foundry, Southern	10 25 @ 10 50
No. 3 foundry, Southern	10 00 @ 10 25
No. 1 soft, Southern	10 75 @ 11 00
No. 2 soft, Southern	10 25 @ 10 50
Foundry forge, Southern	9 75 @ 10 00

Bar Iron—Base—Mill price, in carloads, on dock. Common, 1.07½ @ 1.10c.; refined, 1.15 @ 1.20c. Store prices: Common, 1.25 @ 1.35c.; refined, 1.30 @ 1.50c.

Tool Steel—Base Sizes—Standard quality, 6 @ 7c., with some grades perhaps a little less; extra grades, 11 @ 12c.; special grades, 16c. and upward.

Machinery Steel—Ordinary brands, from store, in small lots, 1.45 @ 1.60c.

Cold Rolled Steel Shafting—Base sizes, from store, in retail lots, 2.15 @ 2.20c.

Copper—Carload lots: Lake Superior ingot, 12c.; electrolytic, 11¾c.; casting copper, 11⅝c.

Pig Lead—Carload lots, 3.75c., f. o. b. New York.

Pig Tin—For 5 and 10 ton lots, 14.35 @ 14.40c., f. o. b.

Spelter—Carload lots, 4.25 @ 4.30c., New York delivery.

Antimony—Cookson's, 8½c.; Hallett's, 7¾c.

Lard Oil—Prime city, present make, 44 @ 46c., in wholesale lots.

Manufacturers.

Another building is going up at the Bath Iron Works plant, Bath, Me.

W. G. Bohn, of Iron River, will build a saw-mill at Mellen, near Ashland, Wis.

Hodge & Co., of Philadelphia, will soon commence the erection of a new planing mill.

It is proposed to enlarge the plant of the Quincy Electric Light & Power Company, Quincy, Mass.

The Russel Car Wheel Company is building for the Detroit, Mich., Copper & Brass Rolling Mills a new mill.

The Boston & Maine Railroad is establishing a machine shop in the old Concord, Mass., railroad roundhouse.

The Wayland, N. Y., Cement Works are going to enlarge their plant this spring and make other improvements.

The M. Campbell Fanning Mill Company, of Chatham, Ont., contemplates the erection of a branch factory at Detroit, Mich.

Architect Thomas Stephen, Camden, N. J., has plans for a four-story factory, 50x150 feet, to be built at Delaware and Cooper streets, Camden.

Worth Brothers & Co., iron manufacturers, Coatesville, Pa., have purchased the old Springton forge, which they will move and erect at their Viaduct Mills.

F. W. Shuls, of Paducah, Ky., has recently purchased ground and will erect a building thereon for the purpose of starting a general repair and machine shop.

The C. C. Riotte Company, of New York city, has been incorporated to manufacture machinery. Incorporators, Wm. H. Peck, Walter Lawrence and C. C. Riotte.

The Binghamton, N. Y., Electrical Company has been incorporated recently. C. F. Terhune, L. M. Blanding and R. E. Prince, of Binghamton, are the directors for the first year.

The National Car Truck Company, of Port Byron, N. Y., has been incorporated. The directors are T. Fayette Dixon, Richard Warren, Wm. Blake and Chas. Thompson, all of Port Byron.

The Colorado Crystal Marble & Granite Company, of Aspen, Col., has been incorporated. Jas. T. Stewart, J. F. MacMillan, Nathan Oakes and Wm. Banning are among the incorporators.

The Richardson Clutch & Gas Engine Company, of Erie, Pa., has accepted the offer of a free site for the location of its manufacturing plant at Grove City, Pa. Work will be commenced at once.

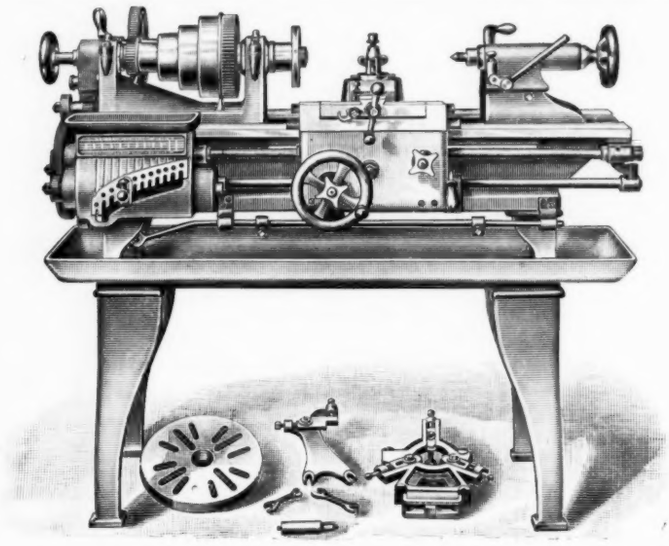
The Woods Specialty Company, of Granville, N. Y., has been incorporated to manufacture hardware, cutlery, etc. F. T. Pember, E. D. Woods, of Granville; Henry T. Seymour, of New York city, and N. T. Boyd, of Poughkeepsie, N. Y., are interested.

A charter has been issued to the George C. Towle Manufacturing Company to manufacture electrical machinery at Lancaster, Pa. Directors, G. C. Towle, J. E. Hubley and R. Blickenderfer, Lancaster; G. A. Towle, Lowell, Mass., and J. P. Williams, of New York.

Contractors Doyle & Doak, 133 South Fifteenth street, Philadelphia, Pa., are receiving estimates on a water works building to be erected at Avalon City, N. J., for the Avalon Water Works Company. It will be brick and iron, one story and basement, measuring 50x100 feet.

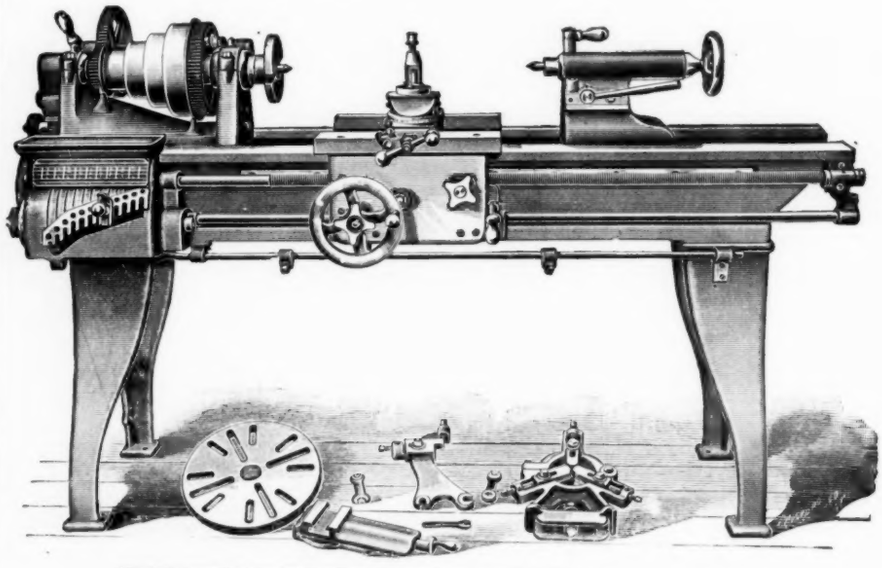
A commission for a charter has been issued to the National Automatic Car Switch & Appliance Company, of Orangeburg, S. C. The company is to be chartered with a capital stock of $100,000. The corporators named are Messrs. Edwin J. Jenkins, Henry H. Brunson and James M. Oliver.

The Hartford City Gas Light Company, of Hartford, Conn., has placed another contract with the Berlin Iron Bridge Company, of East Berlin, Conn., for one of their steel roofs, lined with their patent anti-condensation fireproof roof lining. The new building is about 35 feet



12" Hendey-Norton Lathe

is fitted with drawing-in sleeve and American Watch Tool Co.'s standard chuck, used in making small taps, reamers, etc. Work finished first and cut from bar afterward. No centering required. See carriage reverse lever by right-hand side of apron ; no reaching for countershaft shipper required.



14" x 6' Hendey-Norton Lathe.

These lathes are modern, high-grade, practical tools, and are specially adapted for tool-room work. They have the Norton Attachment for screw cutting, giving 36 different threads and 36 different feeds with only two changes of gear and movement of lever in gear box from one notch to the other. Note the automatic stop under apron. It will automatically stop carriage at any desired point in either direction; invaluable for internal or duplicate work. SEND FOR CATALOGUE.

The Hendey Machine Company.

Torrington, Conn.

Agents for the Pacific Coast, Pacific Tool & Supply Co., San Francisco, Cal.
J. W. Cregar, Philadelphia Bourse Exhibition.

European Agents: Schuchardt & Schutte, Berlin, Vienna, Brussels, Stockholm.
Chas. Churchill & Co., Ltd., London and Birmingham, Eng.
Adphe. Janssens, Paris, France.

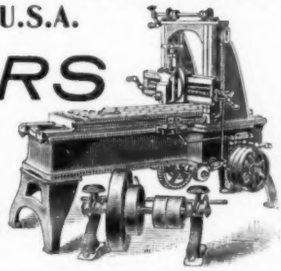
THE PRATT & WHITNEY COMPANY
Hartford, Conn., U.S.A.

PLANERS

To plane 16 in. x 16 in. x 3 ft. to 40 in. x 40 in. x 20 ft. with quick return motion.

PILLAR SHAPERS

With 9 and 14 in. stroke.



SHAPING MACHINES

With 12 in. and 14 in. stroke, all feeds automatic.

Ask for Machinists' Catalog.

NEW YORK—123 Liberty Street.
BOSTON—144 Pearl Street.
CHICAGO—42 South Clinton Street.
LONDON, ENG.—Buck & Hickman, 280 Whitechapel Road.
PARIS, FRANCE—Fenwick Freres & Co., 21 Rue Martel.

9 to 15 in. Swing.
CATALOGUE FREE.

ENGINE and SPEED LATHES

IN VARIOUS LENGTHS—9 to 15 in. SWING.
Latest and Most Approved Designs. Workmanship, Material and Finish of the Highest Order.

SEBASTIAN LATHE COMPANY,
117 and 119 Culvert Street CINCINNATI, OHIO, U. S. A.
Agents: SELIG, SONNENTHAL & CO., London, Eng.; JOHN TRAGARDH & Co., Göteborg, Sweden; E. SONNENTHAL, JR., Berlin, Germany; R. S. STOKVIS & ZONEN, Rotterdam, Holland.

STEAM BOILERS

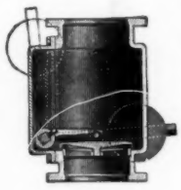
PEABODY & MILLER,	$4.00
FLATHER & WILSON,	2.50
THURSTON BOILERS,	5.00
THURSTON BOILER TRIALS,	5.00

JOHN WILEY & SONS, 53 East 10th St., New York.

Roughing Reamer.

Finishing Reamer

FINE REAMERS.
SPIRAL FLUTES.
Also Screw Plates, Taps, Dies and Machinery.
Send for Catalogue.
WILEY & RUSSELL MFG. CO.
Greenfield, Mass., U. S. A.
Agents in London:
SELIG, SONNENTHAL & CO.,
85 Queen Victoria Street.



Excelsior Straight-Way Back Pressure Valve.

This valve has no dash pots, springs, guides or complicated levers to get out of order. It is simple, reliable and well made. Never sticks, and can be relied upon at all times when using exhaust steam for heating; or when used as a relief, or free exhaust on a condensing plant, it has no equal. It is noiseless and free from any complicated attachments.

JENKINS BROTHERS, New York, Boston, Philadelphia, Chicago.

ACCURACY
DON'T SPOIL IT
BY GUESSING.

Use the Richards' System of measuring machines; these Gauges are guaranteed to $\frac{1}{10000}$ of an inch.
Implements are adjusted at a temperature of 75°.
ASK FOR NEW CATALOGUE JUST OUT.
The John M. Rogers, Boat, Gauge & Drill Works,
GLOUCESTER CITY, N. J., U. S. A.
ACCURACY ACCURACY ACCURACY

MOFFET PORTABLE DRILL.

UNSURPASSED AS A REAMER.

Weighs 481bs. and drills from ½ to 2¼ inches diameter.

RUNS WITH STEAM —OR— COMPRESSED AIR.

Will work in any position.

Send for Circular.

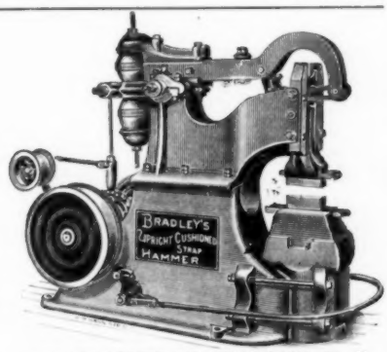
Manufactured by
J. G. TIMOLAT,
465-467 W. Broadway.
NEW YORK.

BRADLEY HAMMERS

Have never been equaled for quantity and quality of output, simplicity, durability and freedom from repairs.

Send for Circulars.

Foreign Agents:
Buck & Hickman, Whitechapel Road, London.
Schuchardt & Schutte, Berlin, Vienna, Brussels.
Fenwick Freres & Co., Paris.



THE BRADLEY CO., SYRACUSE, N. Y.

wide and 70 feet long, having brick sides and iron roof construction as mentioned above.

The Boyer Machine Company, of St. Louis, Mo., is to erect a new machine shop.

The United States Sugar Refinery plant, Waukegan, Ill., is to be enlarged and remodeled.

M. Zier & Co., foundry and machine shops, of Louisville, Ky., have filed articles of incorporation with the Secretary of State, with a capital stock of $25,000.

The directors of the Turner Engine Company, located at Bucyrus, Ohio, have adopted a resolution authorizing the purchase of new machinery to be placed in their new plant at Bucyrus.

A brick manufacturing plant will soon be erected at Camp Run, Pa., a hamlet nine miles west of Dubois. W. R. Meredith & Bro. will erect the plant, which is to be managed by A. C. Moyer, of Tyrone.

The old wooden machine shop of the Illinois Steel Company at the Bay View, Wis., mills is to be replaced by a brick building. This will be the first of a series of improvements to be made upon this plant.

In the office of the Secretary of State has been incorporated the Sutton & Sunderley Co., of Coeymans, N. Y., for the manufacture of brick. The directors and stockholders are John H. Sutton, Conrad F. Sunderley, Jr.

The plant of the Cronk Hanger Company, of Montour Falls, N. Y., was destroyed by fire recently. The loss to the company will reach $50,000. It is undecided whether the company will rebuild or move the plant to some larger place.

The Kentucky Electric Company, Ludlow, Ky., composed of John Devere and associates, to whom was awarded the electric franchise, will soon begin remodeling the old Post Electric Company building, in the river road, for their power house.

The Rawson & Morrison Manufacturing Company, Cambridge, Mass., contemplate making extensive alterations in its plant on Main street. The changes contemplated in the present plant are designed to very nearly double the manufacturing capacity.

The power house of the Consolidated Traction Company at Pittsburg, Pa., the foundation for which is already laid at Twenty-second street, will be erected as soon as a sufficiently low stage of water is obtained in the Allegheny River. This improvement will cost $200,000.

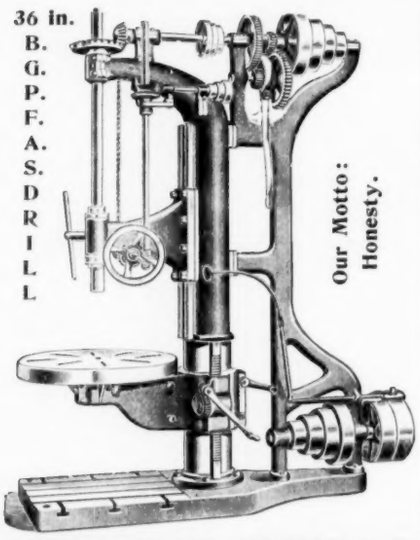
A manufacturing building is to be erected at Scranton, Pa., for the Scranton Button Company from plans prepared by a New York city architect. It will be brick and iron, one story and basement, measuring 110x160 feet, and will be fitted with power equipment and special machinery, to cost $35,000.

The Powell Manufacturing Company, composed of Robt. Powell, of Cleveland, Ohio; F. A. Hahn, of Cincinnati, Ohio, and Geo. Powell, of Covington, Ky., has purchased a building which it is its intention to equip with modern machinery and engage in the manufacture of engines, lathes and planers.

The S. V. Interior Telephone Company, of New York city, has been incorporated to manufacture electric devices. Capital, $30,000. Directors: R. G. Vassar and J. G. Smith, of New York city; J. D. Anderson and W. B. Dall, of Brooklyn, and C. C. Bean, G. S. Tait and O. A. Dall, of Montclair, N. J.

The Sheridan, Devine & Lyon Manufacturing Company, of Newark, N. J., has been incorporated to manufacture metal novelties; capital, $25,000; corporators, James T. Sheridan, East Orange; William P. Devine, Vailsburg, N. Y., and Frederick S. Sayre, Frank C. Haines and Frederick M. Lyon, Newark.

Contractor B. P. Evans, 706 North Ninth street, Philadelphia, Pa., is receiving estimates for the erection of a large silk mill at Ephrata, Pa., for Messrs. Westerhoff Brothers, of Paterson, N. J. It will be brick and iron, three stories, measuring 100x40 feet, and will be equipped with the very latest conveniences and improved machinery. Cost, $30,000.



UPRIGHT DRILLS

OUR SPECIALTY, AND NOTHING ELSE.

We are at the head of our line. We are progressive and wide-awake. We don't know all of it, but do know a few things, and these we attend to.

Sizes: 20 in., 21 in. and 25 in. Stationary Head, B. G. P. F. A. S., and 24 in., 25 in., 28 in., 30 in., 34 in. and 36 in. Sliding Head, B. G. P. F. A. S.; also with Revolving and Compound Tables for special work.

J. E. SNYDER,
Worcester, Mass., U. S. A.

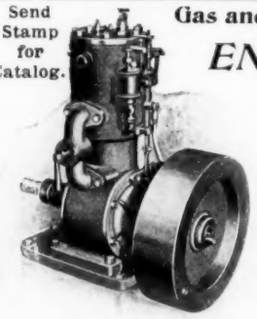
For Advertisement of
Morse, Williams & Co., Philadelphia, Pa.,
See Issue March 17, 1898.

Crank Shapers.

15, 16 and 20 inch. Quick adjustment. Easy of operation. Powerful and accurate in construction.

The R. A. Kelly Machine Co.,
XENIA, OHIO, U. S. A.

Send Stamp for Catalog.



Gas and Gasoline
ENGINES.
Both Stationary and Marine.

Engine Castings
Dynamo and Motor Parts and Complete Machines. Electrical Supplies, Telephones.

MIANUS ELEC. CO., Box A, **Mianus, Conn.**

DRILLS FOR LIGHT WORK.
We make drills from one to eight spindles, hand and automatic feed. Send for price of the
"W. & R. Special"
Double Head Traverse Drills; also Adjustable Two-Spindle Drills, Tapping Machines, Cutter Grinders, Surface Grinders, Centering Machines. Write for Catalogue.
WOODWARD & ROGERS,
HARTFORD. - - - CONN., U. S. A.
European Agents: SELIG, SONNENTHAL & CO., London, England; E. SONNENTHAL, JR. Berlin, Germany.

Between the covers

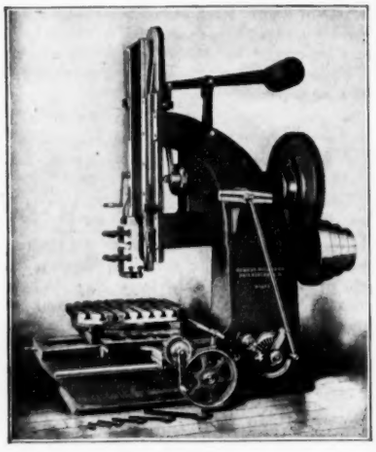
of our catalogue of bench and floor grinding machines will be found some very interesting data in relation to emery wheels—how to use them and what for.

Norton Emery Wheel Co.,
Worcester, Mass.

Montgomery's 1898 Tool Catalog

is ready, and **you** want it at once. It is a necessity. Over 500 pages and a discount sheet. Fully illustrated. Postpaid on receipt of 25 cents.

Montgomery & Co.,
THE TOOL DEALERS,
105 Fulton Street, - - New York City.



Slotters

from 6 in. to 48 in.

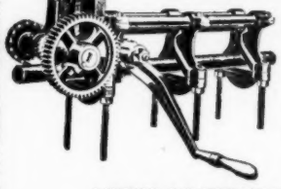
Made in the largest machine tool works in America, where quality and workmanship are first essentials.

Bement, Miles & Co.,
Philadelphia, Pa.

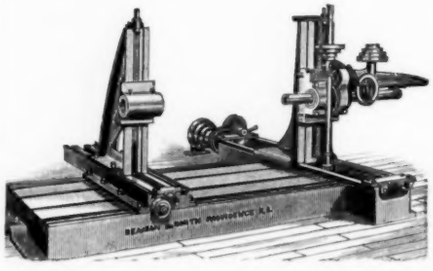
39 Cortlandt St., New York.
1534 Marquette Building, Chicago.

R. K. LeBLOND,
CINCINNATI, O., U. S. A.
NILES TOOL WORKS CO., New York, Eastern Agts.

BURR PORTABLE KEYSEATER.
CUTS PERFECT KEYSEATS.
Any Shaft to 5 in. Dia.



NEEDN'T TAKE SHAFT DOWN.
SELF-CENTERING.
AUTOMATIC FEED.
QUICK RETURN.
LABORER CAN OPERATE IT.
JOHN T. BURR & ON, 32 South 6th St., BROOKLYN, N. Y.
Selig, Sonnenthal & Co., London.



I am very useful and handy, but do not recollect making your acquaintance. Should you desire to know me, please ask BEAMAN & SMITH, Providence, R. I., to send you descriptive pamphlet No. 1, that will introduce and tell all about me.

BOOKS for MACHINISTS, Engineers, Electricians and Practical Men. **Mailed Free.** 96-page Catalogue of Practical Books. Address Norman E. Henley & Co., 132 Nassau St., New York.

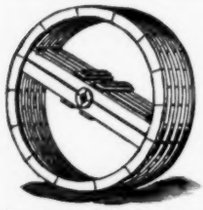
Index to Advertisers.

	PAGE
Acme Machinery Co.	18
Acme Malleable Iron Works	50
Albro-Clem Elevator Co.	15
Almond, T. R.	2
Alteneder & Son, Theo.	51
American Engine Co.	50
American Gas Furnace Co.	2
Armstrong Bros. Tool Co.	16
Armstrong Mfg. Co.	50
Backus Water Motor Co.	43
Baird & Co., Henry Carey	43
Baird Machinery Co., U.	1
Baker Bros.	4
Barnes Co., W. F. & John	42
Baush & Harris Machine Tool Co.	9
"Be Quick"	41
Beaman & Smith	41
Bement, Miles & Co.	14
Bentel & Margedant Co., The	45
Berlin Iron Bridge Co.	51
Besley & Co., Chas. H.	52
Bethlehem Foundry & Machine Co.	2
Betts Machine Co.	5
Bickford Drill & Tool Co.	51
Bickford, H.	52
Bignall & Keeler Mfg. Co.	47
Bilgram, Hugo	4
Billings & Spencer Co.	13
Blaisdell & Co., P.	45
Bliss Co., E. W.	2
Boston Gear Works	43
Bowsher Co., N. P.	14
Box 169	38
Bradford Belting Co.	13
Bradford Mill Co., The	51
Brainard Milling Machine Co.	15
Bristol Co.	52
Brown & Co., R. H.	3
Brown & Sharpe Mfg. Co.	52
Buffalo Forge Co.	52
Builders' Iron Foundry	2
Bullard Machine Tool Co.	47
Bullock Electric & Mfg. Co.	9
Bunker Hill Mfg. Co.	12
Burr Mfg. Co.	40
Burr & Sons, John T.	43
Carborundum Co., The	4
Century Machine Co.	42
C & C Electric Co.	45
Case Mfg. Co.	7
Challenge Machine Co.	41
Chambersburg Engineering Co.	16
Chicago Belting Co.	6
Chicago Pneumatic Tool Co.	6
Cincinnati Milling Machine Co.	44
Cincinnati Screw & Tap Co.	18
Cleveland Machine Screw Co.	4
Cleveland Stone Co.	16
Cleveland Twist Drill Co.	52
Clough, R. M.	51
Columbia University	42
Cook Co., Asa S.	3
Crescent Steel Co.	10
Curtis & Curtis	4
Cushman Chuck Co.	3
Dallett & Co., Thos. H.	47
Davis & Egan Machine Tool Co.	49
Detrick & Harvey Machine Co.	51
Diamond Machine Co.	42
Dixon Crucible Co., Joseph	2 and 6
Doan & Co., J. B.	13
Dreses, Mueller & Co.	16
Eames Co., G. T.	3
Errington, F. A.	3
Evans, C. H.	41
Evans Friction Cone Co.	2
Fay & Scott	43
Fellows Gear Shaper Co.	41
Ferracute Machine Co.	14
Fifield Tool Co.	52
Flather & Co.	45
Foos Gas Engine Co.	50
Forbes & Co., W. D.	50
Foster, Walter H.	45
Frasse Co., Peter A.	41
Frick Co., The	50
Frontier Iron Works	50
Fuel Economizer Co.	10
Gang & Co., Wm. E.	10
Garvin Machine Co., The	15
General Electric Co.	9
Geometric Drill Co.	3
Gisholt Machine Co.	16
Gleason Tool Co.	18
Goddard Machine Co.	12
Goodyear, S. W.	4
Gould & Eberhardt	18
Grant Gear Works	18
Gray Co., G. A.	18
Greenfield, W. G. & G.	50
Hamlin, Geo. R.	38
Hampden Corundum Wheel Co.	14 and 46
Harrington & King Perforating Co.	52
Harlow & Co., C. F.	6
Harrington & Son Co., Edwin	2
Hart Mfg. Co.	1
Hartford Steam Boiler Insp. & Ins. Co.	38
Henderer's Sons, A. L.	42
Hendey Machine Co.	39
Henley & Co., N. E.	16
Hill, Clarke & Co.	13
Hill Tool Co., Hugh	6
Hilles & Jones Co.	14
Hoggson & Pettis Mfg. Co.	3
Hoppes Mfg. Co.	45
Horton & Son Co., E.	3
Hurlbut-Rogers Machine Co.	14
Hyatt Roller Bearing Co.	2
Ineson, A. F.	18
Ingersoll-Sergeant Drill Co.	7
Ingersoll Milling Machine Co.	40
International Correspondence Schools	43
Jenkins Bros.	40
Jessop & Sons, Wm.	4
Jones & Co., B. M.	2
Jones & Lamson Machine Co.	18
Kelley Machine Co., R. A.	41
Kempsmith Machine Tool Co.	42
Keuffel & Esser Co.	47
Keystone Electric Co.	42
Landis Tool Co.	51
Le Blond, R. K.	16
Le Count, Wm. G.	3
Lodge & Shipley Machine Tool Co.	8
Long & Alstatter Co.	4
Mass. Charitable Mechanic Association	10
McCabe, J. J.	12 and 13
Mergenthaler & Co., Ott.	10
Merrill Mfg. Co.	7
Metal Specialty Co.	38
Meitz & Weiss	50
Mianus Electric Co.	50
Mitts & Merrill	2
Moline Elevator Co.	10
Montgomery & Co.	42
Morse Twist Drill & Machine Co.	17
Morse, Williams & Co.	51
Mossberg & Granville Mfg. Co.	47
Newark Machine Tool Co.	3
New Era Iron Works	50
New Haven Mfg. Co.	4
Newton Machine Tool Works, Inc.	6
Nicholson File Co.	10
Niles Tool Works Co.	18
Niles Tool Works Co., New York Branch	13
Norton Emery Wheel Co.	7
Nya Aktiebolaget Atlas	12
Ober Lathe Co.	7
Oesterlein, W.	6
Otto Gas Engine Works	50
Page's Sons, Isaiah	42
Pawling & Harnischfeger	18
Pearson Machine Co.	52
Philadelphia Book Co.	47
Philadelphia Bourse	44
Poole & Son Co., Robert	3
Pope Tube Company	46
Port Chester Bolt & Nut Co.	13
Powell Planer Co.	8
Pratt Chuck Co.	3
Pratt & Whitney Co.	40
Prentice Bros.	48
Prentiss Tool & Supply Co.	13
Q & C Co.	38
Quint, A. D.	7
Rahn & Mayer	14
Rand Drill Co.	50
Reed Co., F. E.	14
Reed Mfg. Co.	10
Reeves Pulley Co.	12
Reinecker, J. E.	7
Rogers Boat Gage & Drill Works, John	6
Rue Mfg. Co.	50
Sackman, F. A.	16
Safety Emery Wheel Co.	6
Saunders' Sons, D.	16
Sawyer Tool Co.	41
Sebastian Lathe Co.	40
Sellers & Co., Inc., Wm.	18
Seneca Falls Mfg. Co.	42
Sessions Foundry Co.	16
Shriver & Co., T.	43
Shultz Belting Co.	18
Sibley & Ware	6
Skinner Chuck Co.	3
Slocomb & Co., J. T.	47
Smith & Mills	4
Spencer Auto. Machine Screw Co.	6
Sperry Engineering Co.	50
Spon & C.	15
Springfield Gas Engine Co., The	50
Springfield Machine Tool Co.	17
Stafford, Arthur	41
Standard Tool Co.	52
Starrett Co., L. S.	47
Stiles Press Co., E. S.	4
Stover Novelty Works	4
Stow Flexible Shaft Co.	51
Stuart's Foundry & Machine Works, R. J.	52
Tabor Mfg. Co.	50
Tight Joint Co.	41
Timolat, J. G.	45
Toledo Machine & Tool Co.	3
Toomey, Frank	13
Trump Bros Machine Co.	3
Turner, Vaughn & Taylor Co.	12
T. & B. Tool Co.	18
U. S. Metallic Packing Co.	12
Van Duzen Gasolene Engine Co.	50
Van Duzen, E. W.	13
Wais & Roos Punch & Shear Co.	51
Walcott & Son Geo. D.	10
Walker Company	16
Waltham Watch Tool Co.	45
Warner & Swasey	52
Watkins Co., F. M.	50
Watson-Stillman Co., The	45
Weber Gas & Gasolene Engine Co.	50
Webster Co., Warren	50
Webster Mfg. Co.	50
Webster & Perks Tool Co.	10
Weipert & Son, J.	45
Westinghouse Electric Mfg. Co.	17
Whitcomb Mfg. Co.	7
Whitney, Baxter D.	15
Whitney Mfg. Co.	17
Whiton Machine Co., D. E.	14
Wiley & Sons, John	40
Wiley & Russell Mfg. Co.	40
Williams, White & Co.	43
Woodward & Rogers	48
Worcester Machine Screw Co.	4
Wyke & Co., J.	43
Wyman & Gordon	52

▲ ▲ ▲

Contents.

	PAGE
Accurate Screw Machine Work.—Automatic vs. Hand Screw Machines. By J. O. Surface	19
Quick Work	19
Rights of Partners and Stockholders in Manufacturing Concerns to Patents on Inventions. By D. Walter Brown	20
The Proportions of Compound Air Compressor Cylinders to Secure Best Economy.—Economy of Compounding. By F. A. Halsey	20
The Determination of the Size and Number of Turns of Wire in a Constant Speed Motor. By William Baxter, Jr.	22
A Cheap Arrangement for Cooling Condensing Water	24
Relative Economy of Gas Engine and Electric Motor for Shop Driving	24
Military Telescopes for Sea-coast Defense and Gun-boat Use	24
A New Steam Separator	25
The Metric System in England	25
The Stimulus of the Patent	26
The Equities of Dealing with European Agents and American Commission Houses	26
Letters from Practical Men: A Roughing Tool for the Planer. By A. D. Williams....Straddle Tools.—Turning Gear Blanks. By W. L. Schellenbach....Translations of Trade Catalogs.—A Case of Blundering in Russian. By W. F. Dixon....Micrometer Lathe-carriage Stop. By Charles W. Wright....Hack Saws. By Walter Gribben....A Soldering and Brazing Rig. By Machinist....Milling Dovetail Slots.—The Milling Machine for Slotting. By W. R. G....The Boys and the Shop. By Tecumseh Swift....The Artist Draftsman. By Cisnarf....A Ring Bending Job. By O. L. Dohip.	27-31
International Registration of Trade Marks	31
High Range Compressed Air for War Ships. By Frank Richards	32
Locomotives for the East	32
Foreign News Notes	33
Technical Publications	33
Mathematical Analysis as Applied to Machine Construction	34
Translations of Trade Catalogs	34
Questions and Answers	35
The Mechanical Engineering Department of Columbia University	36
Meeting of American Foundrymen's Association	36
Personals	37
Inquiries for Machinery	37
Commercial Review	37



"The Reeves" Wood Split Pulley,

with interchangeable bushing system for belt power transmission.

Lighter than an iron pulley. Stronger than a steel pulley. Each pulley will fit thirty-five sizes of shaft. No set screws. No key-way. Complete stocks carried in every jobbing center in the United States. Also:

CHAS. CHURCHILL & Co., 9 to 15 Leonard St., London, Eng.
SCHUCHARDT & SCHUTTE, Berlin, Brussels, Milan.
FENWICK FRERES & Co., 21 Rue Martel, Paris, France.
WHITE, CHILD & BENEY, Vienna, Austria.

Reeves Pulley Co., Columbus, Ind., U. S. A.,
Send for Catalogue. **Manufacturers.**

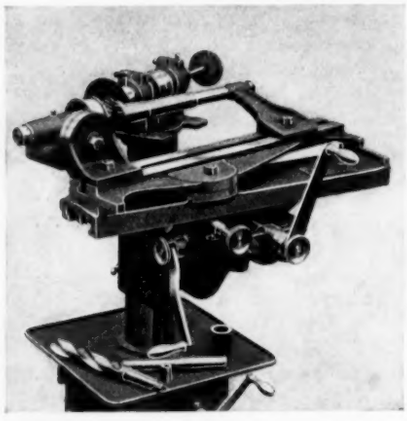
THE
TURNER, VAUGHN & TAYLOR CO.
CUYAHOGA FALLS, OHIO, U. S. A.
Special Machinery for
Chain Factories and Wire Mills.
PATENTED CHAIN WELDING HAMMERS.

We make Piston Rod Packings that do not leak. Many thousands are in use, giving the very best of satisfaction. We are the oldest makers of Metallic Packings in the business, and know how.

U. S. Metallic Packing Co.,
425 North 13th St., PHILADELPHIA, PA.

Tool Grinder.

PRICE, $280 NET.



Nya Aktiebolaget Atlas,
STOCKHOLM, SWEDEN.

This is the best die

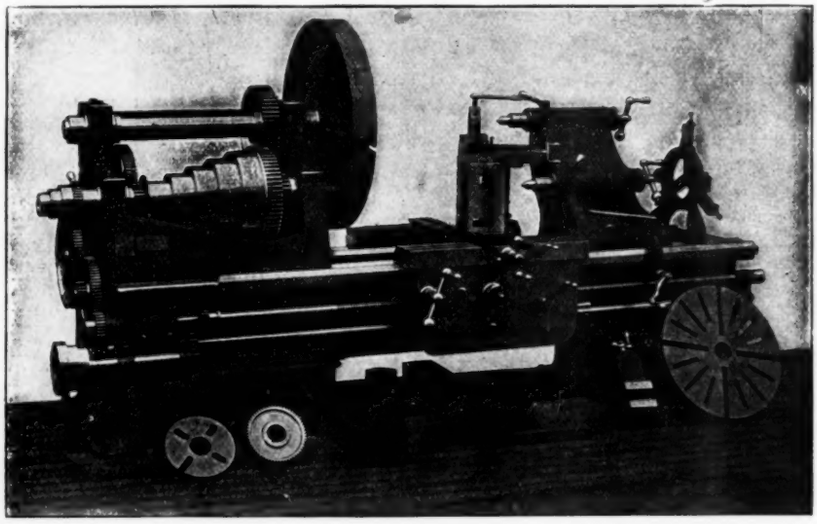
of its kind made, and we have all of the data at hand to prove it. It is intended for use on turret headed machines and on lathes with hollow spindles, and will save 50 per cent. in the cost of thread cutting.

Bunker Hill Manufacturing Company,
16 N. Canal St., Chicago, Ill.

A dollar, more or less,

spent on a lathe—provided you get the right one, say a Goddard Lathe for instance—doesn't amount to much.

Goddard Machine Co., Holyoke, Mass.



The Double Spindle Lathe

is actually two lathes in one—a regular 26 in. and triple geared 44 in., capable of turning out work rapidly and accurately, from the smallest class up to 44 in. Solid in construction, wide range of speeds and feeds, changed in a moment for any kind of ordinary work, and costs but a trifle more than a regular 26 in. lathe. Ask who use them and what they think of them.

J. J. McCabe, 14 Dey St., New York.

Second-Hand Tools.

MODERN STYLE, A 1 ORDER.

PLANERS.

48 in. x 16 ft. Putnam Machine Co.'s.
42 in. x 14 ft. Powell, 4 heads, extra heavy.
38 in. x 10 ft. Pond.
36 in. x 8 ft. Bement.
30 in. x 8 ft. G. A. Gray Co.'s latest.
26 in. x 6 ft. Pond Machine Tool Co.
22 in. x 5 ft. Putnam Machine Co.'s

SHAPERS.

12 in. Crank, Gould & Eberhardt.
14 in. Traveling Head, Fitchburg.
16 in. Friction Geared, Prentiss.
24 in. Crank, Gould & Eberhardt.
24 in. Friction Geared, Hendey.

DRILLS.

21 in. swing, Prentice, back geared.
22 in. swing, Barnes, back geared, auto. feed.
25 in. swing, Lodge & Davis, back gear., auto. fd.
28 in. swing, Barnes, back geared, auto feed.
30 in. swing, Prentice, back geared, auto. feed.

RADIAL DRILLS.

72 in. swing, complete with tapping attach.
120 in. swing, Bement, Semi-Universal.
160 in. swing, Baush, complete, extra heavy.

LATHES.

90 in. x 20 ft. Extension Bed, extra heavy.
40 in. x 20 ft. Pond, extra heavy.
32 in. x 18 ft. Fay & Scott.
26 in. x 14 ft. Perkins.
24 in. x 12 ft. Putnam.
22 in. x 10 ft. Pond.
20 in. x 8½ ft. New Haven.
18 in. x 8 ft. Flather.
16 in. x 6 ft. Fitchburg, taper attachment.
14 in. x 6 ft. Putnam, for tool work.
12 in. x 5 ft. Reed & Prentice.

MILLING MACHINES.

Universal, Kempsmith, tool size.
Universal, Brainard No. 15, tool size.
Universal, Cincinnati No. 4, large size.
Automatic feed, Plain Garvin No. 12.
Automatic feed, Plain Garvin, old No. 2.
Ingersoll Slab Miller, 22 in. x 5 ft.

SCREW MACHINES.

2 1-8 in. wire feed, Jones & Lamson, all att's.
1 5-16 in. wire feed, Jones & Lamson, all att's.
1 5-32 in. wire feed, Bardons & Oliver, latest.
9-16 in. wire feed, Jones & Lamson.

MISCELLANEOUS.

Automatic Gear Cutter, 36 in. Gould & Eberhardt.
Horizontal Boring and Drilling Mach., Sellers.
Bolt Cutter, automatic, 1¼ in., National.
Profiling Machine, one spindle, Garvin.
Cutting-off Machine, 2 and 3 in.
Power Presses, Stiles and Bliss.
Power Hammer, 50 lbs.
Steam Hammer, 500 lbs., Bement.

J. J. McCABE,
14 Dey Street,
NEW YORK.
Philadelphia Branch: The Bourse.

FOR SALE.

One Hornsby-Akroyd Oil Engine of 30 H. P. Has been run only a short time, and guaranteed as good as new. To be sold only for the reason that we have put in a much larger Engine, which renders its continued use unnecessary.

PORT CHESTER BOLT AND NUT CO.,
Port Chester, N. Y.

SECOND-HAND MACHINERY.

ENGINE LATHES.

1 14 in. x 3 ft. 6 in. Putnam.
5 14 in. x 6 ft. F. E. Reed.
1 15 in. x 6 ft. Star.
1 15 in. x 6 ft. Wood & Light.
1 16 in. x 5 ft. Ames.
1 16 in. x 7 ft. Dustin & Hubbard.
1 18 in. x 8 ft. Dustin & Hubbard.
1 21 in. x 9 ft. Pratt & Whitney.
1 24 in. x 13 ft. Lathe & Morse.
1 27 in. x 10 ft. Dustin & Hub.
1 28 in. x 12 ft. Wood & Light.
1 32 in. x 13 ft. Bement.
1 48 in. x 18 ft. G. & S.
1 Pit Lathe, 72 in. x 18 ft.

PLANERS.

2 16 x 16 in. x 4 ft. Hendey.
1 24 x 24 in. x 6 ft. Powell.
1 24 x 24 in. x 7 ft. Lathe & Morse.
1 28 x 28 in. x 8 ft. G. & S.
1 30 x 30 in. x 10 ft. Niles.
1 32 x 36 in. x 14 ft. grade, 2 hds.
1 36 x 36 in. x 12 ft. Powell, 2 heads.
1 36 x 36 in. x 18 ft., Wm. Sellers.
1 48 x 32 in. x 6 ft. Pond, 2 hds.

SHAPERS.

1 9 in. Traveling Head, Wm. Sellers.
1 13 in. Traveling Head, Bement.
1 15 in. Crank Motion, Springfield.
1 15 in. Crank Motion, Kelly.

MILLING MACHINES.

2 No. 1 Garvin Universals.
1 No. 1 Cincinnati Universal.
1 No. 15 Garvin, back geared.
1 Pratt & Whitney, Grant Patent.

DRILLS.

1 34 in. Harris Bk. G'd.
1 22 in. Prentice Bk. G. & P. F.
1 3-Spindle Hendey.
1 No. 3 4-Spindle Garvin.
1 6-Spindle Quint.
4 Suspension Drills, Pond's.

SCREW AND CHUCKING MACHINES.

1 No. 2 P. & W. Wire Feed.
1 No. 2 P. & W. Plain.
1 No. 4 Windsor Plain.
1 No. 4 Windsor Wire Feed.
1 No. 4 W. & S. Bk. G'd.
1 No. 4 W. & S. and P. F.
1 No. 2 Niles, with tools.
1 18 in. P. & W. Chucking Machine.

MISCELLANEOUS.

1 51 in. Niles B. & T. Mill, 1 head.
1 3 ft. Portable Riveter.
1 Heavy Splitting Shear.
1 Whiton Centering Machine.
1 Circular Shear.
2 Garvin Cutter Grinders.
1 No. 2 Bement Hor. B. & D. Machine.
1 No. 2 Fedrick & Ayer Cyl. Borer.
1 2 in. H. & R. Cutting-off Machine.
3 Bolt Cutters, different sizes.
1 10 in. New Haven Slotter.
1 P. & W. Double Cam Cutter.

Send for Circular. Prices on application.

THE NILES TOOL WORKS CO.,
138 Liberty Street, New York City.

FOR SALE:

1 Gray Lathe, 32 in. swing, 12 ft. bed.
1 Gray Lathe, 20 in. swing, 8 ft. bed.
1 Lodge & Davis, 20 in. swing, 8 ft. bed.
1 Mueller, 18 in. swing, 8 ft. bed.
1 Lodge & Davis, 14 in. swing, 8 ft. bed.
1 Milling Machine; one 18 in. Shaper.
1 Planer, Lodge & Davis, 24 x 24 x 48.
1 2 in. Pipe Cutter, 2 vertical Boring Mills.

Address: **E. W. VANDUZEN,**
104 East Second St., Cincinnati, Ohio.

Almost New Machine Tools

—AT—

SECOND-HAND PRICES.

1 Gleason Triple Geared Lathe, 72 in. x 52 ft.
1 " " " " 42 in. x 33½ ft.
1 " " " " 38 in. x 27 ft.
1 Bement-Miles Slotter, 48 in. stroke.
1 " " " 18 in. "
1 English Slotter, 14 in. stroke.
1 Gleason Planer, four heads, 72 in. x 72 in. x 12 ft.
1 " " " " 42 in. x 42 in. x 12 ft.
1 Universal Radial Drill, 5 ft. arm.
1 No. 1 Betts Horizontal Boring Machine.
1 63 in. Pond Vertical Boring Mill.
1 Morgan Electric Crane, 15 tons.
1 Brown Engine, 120 H. P.
3 Dynamos.

HILL, CLARKE & CO.

156 Oliver Street, BOSTON, MASS. | **12 South Canal Street, CHICAGO, ILL.**

THE BRADFORD BELTING CO.

CINCINNATI, OHIO, U. S. A.

"MONARCH" RIVETLESS LEATHER BELTING.

Write for Catalog "A."

DROP FORGED TOOL STEEL MACHINISTS' HAMMERS.

Machinists' Tools and Drop Forgings
OF EVERY DESCRIPTION.

THE BILLINGS & SPENCER CO., Hartford, Conn., U. S. A.

We Have in Stock

four 16 inch x 6 feet engine lathes made by F. E. Reed & Co., with master screws, raise and fall tool rests and taper attachments, used short time but good as new. Price each, $285. Also large stock of other second-hand machinery, modern and in good condition.

J. B. DOAN & CO.,
68-70 South Canal Street, Chicago.

BARGAINS IN

NEW AND SECOND-HAND MACHINERY.

Lathes, from 12" to 48"; Planers, from 20" up to 60" 48", 54" and 60" Radial Drills; No. 2 Newton Milling Machine; No. 2 Screw Machine; Shapers, from 6" to 30", Boilermakers' Punches, Shears, Edge Planers, Rolls, Drills, Engines, Boilers, Pumps, and Dynamos.

FRANK TOOMEY, 131 N. THIRD ST., PHILA.

New Lot of

SECOND-HAND MACHINERY.

LATHES.

80 in. x 21 ft. Wilmarth triple geared eng. lathe.
76 in. x 25 ft. Niles Tool Works triple geared eng. lathe, (latest pattern).
44 in. x 18 ft. N. Y. St. Eng. Co. triple gear. eng. lathe.
30 in. x 16 ft. Pond Machine Tool Co. eng. lathe, C. rest and P. C. feed.
22 in. x 18 ft. L. W. Pond eng. lathe, C. rest and P. C. fd.
20 in. x 11 ft. Sellers eng. lathe, C. rest and P. C. feed.
18 in. x 10 ft. N. Y. Steam Eng. Co. eng. lathe, C. rest and P. C. feed.
16 in. x 9 ft. Hendey-Norton eng. lathe, all attachments.
2 16 in. x 8 ft. Bogert eng. lathes, elev. weighted rest.
2 14 in. x 6 ft. Bogert eng. lathes, elev. weighted rest.
2 14 in. x 6 ft. Reed eng. lathes, raise and fall rest.
2 14 in. x 6 ft. Lodge & Davis eng. lathe, raise and fall rt.
1 each 10 in. x 4 and 5 ft. Reed eng. lathe, raise and fall rest.

PLANERS.

42 in. x 42 in. x 12 ft. Gleason, 4 heads, good as new.
42 in. x 42 in. x 16 ft. Bement, 1 head, fair.
30 in. x 30 in. x 8 ft. Wilson, good order.
30 in. x 30 in. x 8 ft. N. Y. Steam Eng. Co., good order.
24 in. x 24 in. x 6 ft. Lodge & Davis, heavy pattern.
24 in. x 24 in. x 5 ft. Gray, latest pattern.
16 in. x 16 in. x 4 ft. Hendey (has Newell vise), latest pt.
15 in. x 15 in. x 12 in. Blaisdell crank planer.

SHAPERS.

24 in. Hendey Friction, medium weight.
17 in. Prentiss Crank, adjustable stroke.
2 16 in. Gould & Eberhardt, adjustable stroke.
16 in. Hendey Friction, latest pattern.
13 in. Betts Crank, traveling head.

DRILLS.

6 ft. arm Putnam Radial, heavy pattern.
1 each 3 and 4 ft. arm Betts, good as new.
40 in. swing, Betts, upright, B. G's and P. feed.
36 in. swing, N. Y. Steam Eng. Co., upright B. G's and P. feed.
32 in. swing, Pratt & Whitney, upright, B. G's and P. fd.
26 in. swing, Snyder, upright, B. G's and P. feed.
1 each 1, 2, 3 and 4 spindle, Sensitive, B. G's and P. fd.
3 21 in. Prentice Bros., B. G's and wheel feed.

MILLING MACHINES.

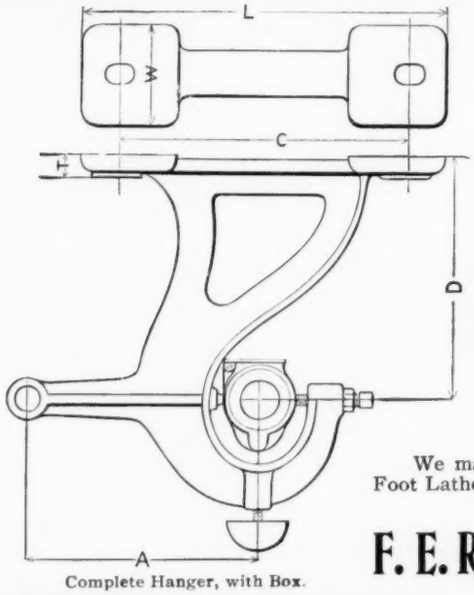
No. 2 Cincinnati Universal, B. G's, latest pat., vert. att.
No. 1 Brown & Sharpe Universal, complete with arm.
No. 1 Brown & Sharpe Universal, complete without arm
No. 2 Brown & Sharpe, plain, B. G's, old pattern.
No. 2 Bogert, plain, G. B. G's, heavy.
No. 2 Newton, plain, B. G's, 40 in. table.
25 in. Gould & Eberhardt, aut. gear cutter.
No. 3 Brainard, plain, B. G. miller.
No. 3 Garvin, plain, miller.

MISCELLANEOUS.

3 large Bliss double crank press., 1 10 in. bet. h ousings.
No. 3 1-2 Bliss, B. G. double crank press and lot bolsters and die bed, 36 in. hole.
No. 61 Bliss Notching Press, with dial feed and lot dies.
1 each Bullard Armature Winding Lathes, 49 and 33 in. swing.
Style "C" Newark Hor. Boring and Drilling Machine, 3 in. bar, 12 ft. table.
56 in. x 12 ft. Nicholson & Waterman Hor. Boring Machine, good as new.
72 in. Michel Vert. Boring and Turning Mill, 2 heads.
60 in. Bement Vert. Boring and Turning Mill, 1 head.
37 in. Bullard Vert. Boring and Turning Mill, 2 heads.
2 in. ellers Aut. Bolt Cutter, set taps and dies.
1 1-4 in. Adams Aut. Bolt Cutter, good as new.
18 in. Stroke Putnam Slotter to center 60 in., all feeds.
No. 5, 100 lb. Beaudry Power Hammer.
No. 2 1-2 Pratt & Whitney Screw Mach., W. F. & Fr. hd.
No. 3 Pratt & Whitney Screw Mch., W. F.
No. 2 Pratt & Whitney Screw Mch., W. F.
7 in. Bement Slotter, all feeds.
1000 lb. Bement Steam Hammer, double column.
Lot Friction Drop Hammers, 300 to 1,000 lbs.

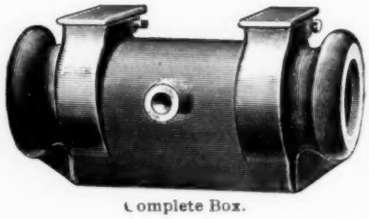
Full particulars on application.

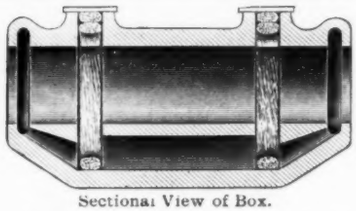
Prentiss Tool & Supply Co.,
115 Liberty St., New York.
Chicago Store: 62-64 So. Canal St.



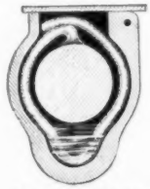
Complete Hanger, with Box.

New Self-Oiling Hanger.


Complete Box.


Sectional View of Box.

A practical, satisfactory self-oiling countershaft Hanger. We furnish them on all our Patent Friction Countershafts. Complete description with dimension and prices on application.


Oil Chamber and Oiling Wick.

We make Engine Lathes, 10 inch to 30 inch swing; Hand Lathes, Foot Lathes, Stud Lathes, Chuck Lathes, etc.

F. E. Reed Company, Worcester, Mass., U. S. A.

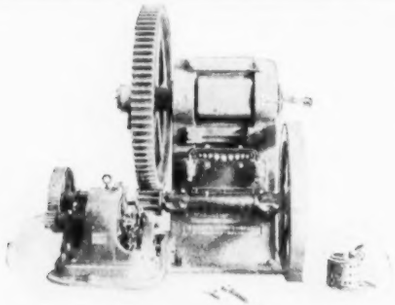
IMPROVED 16" & 18" **ENGINE LATHES**

RAHN & MAYER
216 W. Pearl St.,
CINCINNATI,
OHIO, U. S. A.

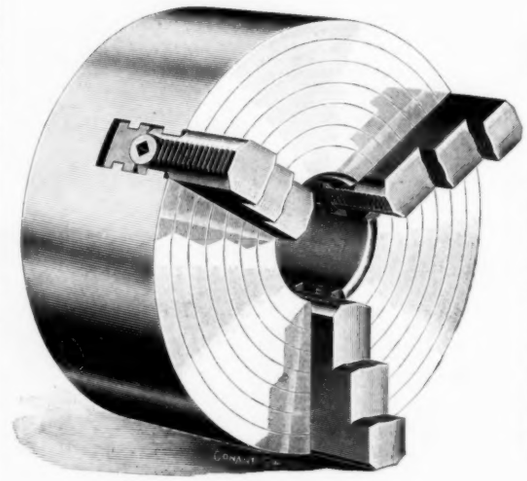
PRESSES (FOOT AND POWER),
DIES AND OTHER TOOLS
FOR SHEET METAL WORK.
NEW STYLES, IMPROVED DESIGN AND CONSTRUCTION.
SEND FOR CATALOG.
FERRACUTE MACHINE CO., Bridgeton, N. J., U. S. A.

CUTTING OFF MACHINES,

the Latest and Best.
HURLBUT ROGERS MACHINE CO.,
SO. SUDBURY, MASS.
German Agents: Schuchardt & Schutte, Berlin and Vienna.
English Agents: Chas. Churchill & Co., Ltd., London and Birmingham.


No. 2 BAR-IRON SHEAR—MOTOR DRIVEN.

Hilles & Jones Company,
902 Church St., WILMINGTON,
DELAWARE.



A Chuck

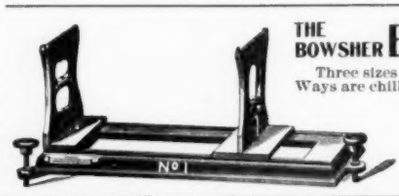
like this will give satisfactory service until it is completely worn out, and it won't wear out in a whole long time. Like all Whiton Chucks it's made by the best of workmen from the best material we can buy. Book ?

D. E. Whiton Machine Co., New London, Conn, U. S. A.
Selig, Sonnenthal & Co., London.

Skill, Reputation, Experience and the unstinted use of the finest materials and labor make the products of

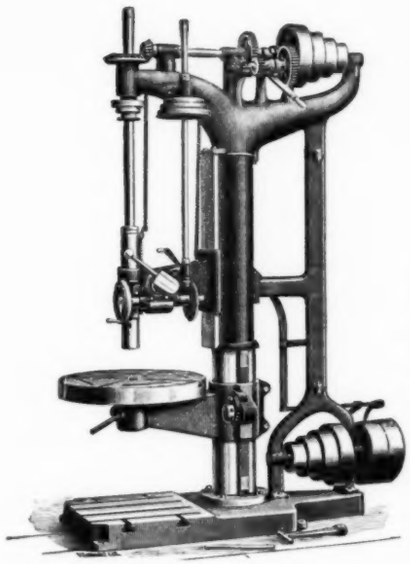
Bement, Miles & Co. what they are —The finest.

Philadelphia,
New York,
Chicago.



THE BOWSHER **Balancing Way,** For balancing Armatures, Pulleys, Cutter Heads and all rotary parts of machinery.
Three sizes and styles for bench and floor use. Ways are chilled and ground. Spirit levels attached.
YOU GET AN ABSOLUTE LEVEL IN TEN SECONDS.
A TIME SAVER. PAYS FOR ITSELF IN 30 DAYS.
Ask for Circular Q.
N. P. Bowsher Co., South Bend, Ind.

Emery and Corundum Wheels and Grinding Machinery. **Emery** and Corundum in Bulk. **Hampden Corundum Wheel Co.,** Write for Circular C. **BRIGHTWOOD, MASS**



DRILL PRESSES.

Six Sizes, strongly back braced.
24, 28, 32, 36, 40, 44 inches,

Improved Sliding Head,
Quick Return,
Automatic Stop,
Graduated Spindle,
Swinging Table,
T Slotted Base and Table,
Large number of Feeds.

Many new improvements not found on other tools.

MACHINE TOOLS OF EVERY DESCRIPTION.

THE GARVIN MACHINE CO.,

Spring and Varick Streets,
NEW YORK.

BERLIN STORE:
THE GARVIN MACHINE CO., m. b. H.,
17 Burg Strasse,
Berlin, C, Germany.

AGENTS IN GREAT BRITAIN:
C. W. BURTON, GRIFFITHS & CO.,
23a Ludgate Hill,
London, E. C., England.

PHILADELPHIA STORE:
51 North Seventh Street, Philadelphia, Pa.

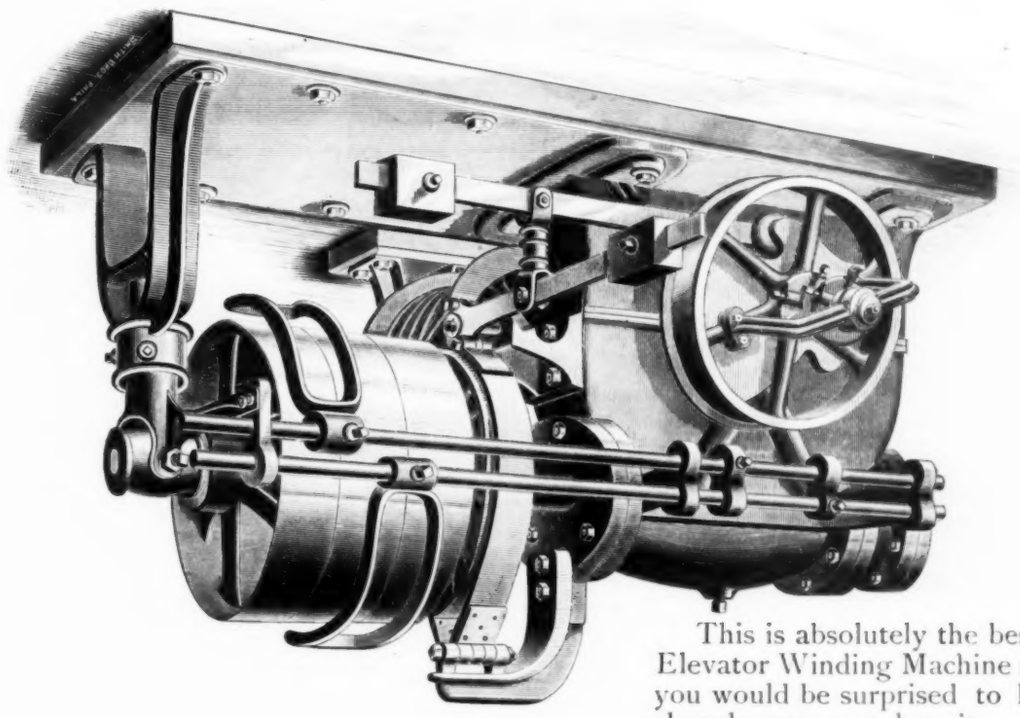
If you are in need of a
FIRST-CLASS
Milling Machine
Write to the
Brainard Milling Machine Co.
Factory, Hyde Park, Mass.
Offices with Hill Clarke & Co., Boston and Chicago.

See Redwood's New Book on
GREASES.
SPON & C., 12 Cortlandt St., New York.

Your money is well invested

When spent on a Whitney Hand Planer.

Baxter D. Whitney,
Winchendon, Mass., U. S. A.

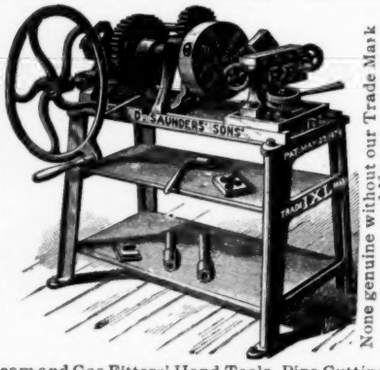


This is absolutely the best Freight Elevator Winding Machine made, and you would be surprised to learn how cheaply you can buy it. Ask now. Don't wait.

Albro-Clem Elevator Co., Philadelphia, Pa., U. S. A.

D. SAUNDERS' SONS,

Manufacturers of the Original
TRADE I. X. L. MARK.
Pipe Cutting and Threading Machine.



BEWARE OF IMITATIONS. None genuine without our Trade Mark and Name.

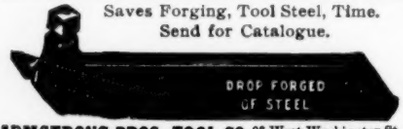
Steam and Gas Fitters' Hand Tools. Pipe Cutting and Threading Machines for Pipe Mill use a specialty.
SEND FOR CIRCULAR.
21 Atherton St., YONKERS, N. Y.

Mark Your Tools With a Steel Stamp.

SEND FOR PRICE LIST No. 4.

HYDRAULIC RIVETERS, FIXED and PORTABLE Types,
For Every Variety of Work. All numbers and sizes.
HYDRAULIC CRANES, Hydraulic Flanging and Forging Presses.
STEAM HAMMERS.
CHAMBERSBURG ENGINEERING CO.,
Main Office and Works, Chambersburg, Pa.
Pittsburg Agts.: Manning, Maxwell & Moore, Telephone Bldg.

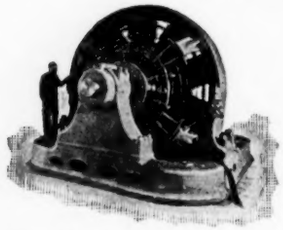
ARMSTRONG LATHE AND PLANER TOOL.
Saves Forging, Tool Steel, Time.
Send for Catalogue.



ARMSTRONG BROS. TOOL CO. 98 West Washington St., CHICAGO, ILL.

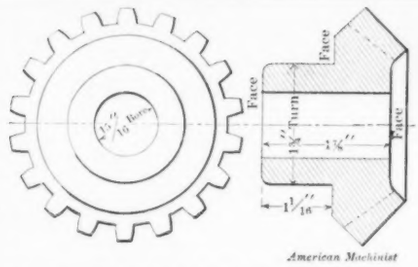
WALKER COMPANY

ELECTRICALLY DRIVEN
Cranes and Hoists,
Motors for Mills
and Factories.



Generators for
Lighting and Power,
Mining Machinery, Etc.

CLEVELAND, OHIO.



Cast gear finished as indicated in 6 minutes.

Results

are what count.

If you can handle duplicate work on a Gisholt Turret Lathe with a saving of from 40 to 80 per cent., it would seem as though your path of duty lay clear to an investigation at least.

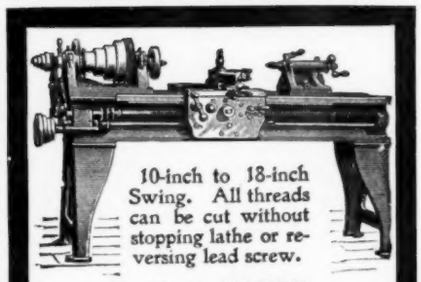
Gisholt Machine Co., Madison, Wis., U. S. A.

Agents:
Eastern Branch, 126 Liberty St., New York; Walter H. Foster, Manager. U. Baird Machinery Co., Pittsburg, Pa.; C. W. Burton, Griffiths & Co., Ludgate House, 23a Ludgate Hill, London, E.C., England; Fenwick Freres & Co., 21 Rue Martel, Paris, France; Schuchardt & Schütte, Spandauer-Strasse, 59-61, Berlin, C., Germany; Schuchardt & Schütte, Breitegasse, 17, Vienna, VII., Austria.

GRINDSTONES

for finishing castings, tool sharpening, etc. Let us select a grit exactly suited to your work.

The Cleveland Stone Co.,
Euclid Avenue, Cleveland, Ohio.



10-inch to 18-inch Swing. All threads can be cut without stopping lathe or reversing lead screw.

R. K. LeBLOND,
CINCINNATI, O., U. S. A.
NILES TOOL WORKS CO., New York, Eastern Agts.

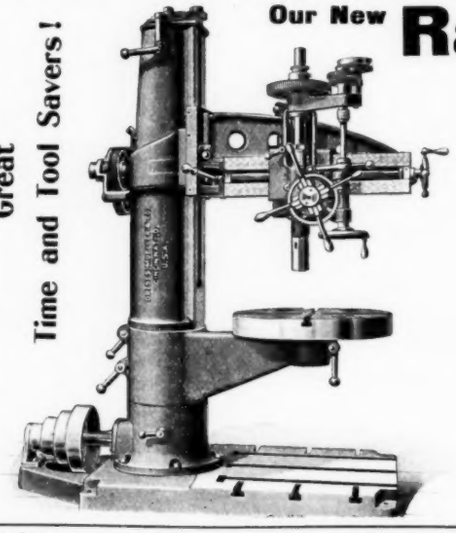
If your castings

are made by the Sessions Foundry Co. you don't have to lay awake nights wondering whether you'll get 'em on time or not. Promptness and quality are strong points with the Sessions Foundry.

The Sessions Foundry Co.,
Bristol, Connecticut, U. S. A.

No Special Tapping Device Needed.

Great Time and Tool Savers!



Our New Radial Drills
ARE LEADING.

The LEVER in front of operator **Starts, Stops, Engages** the **Back Gears** and **Reverses** quick for **Tapping**—all while the machine is running.

New Quick Return. New Feed Device.

Dreses, Mueller & Co.,
Cincinnati, Ohio, U. S. A.

Manning, Maxwell & Moore, New York. Pittsburg and Chicago.
Selig, Sonnenthal & Co., London.
E. Sonnenthal, Berlin.
V. Lowener, Copenhagen.
G. Koeppen & Co., Moscow.

BOOKS for MACHINISTS, Engineers, Electricians and Practical Men. **Mailed Free.** 96-page Catalogue of Practical Books. Address Norman E. Henley & Co., 132 Nassau St., New York.

HAVE YOU SEEN OUR 1898 CATALOGUE?

MORSE TWIST DRILL AND MACHINE CO.,
NEW BEDFORD, MASS.

THE WHITNEY MFG. CO.,

Hartford, Conn., U. S. A.

• • •

HAND MILLING MACHINES

AND

WATER TOOL GRINDERS.

Contributions to Science.

The name of WESTINGHOUSE is a guarantee.

Stillwell Regulators,
Shallenberger Meters,
Tesla Polyphase System,

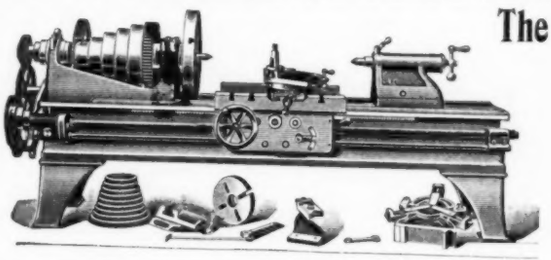
Scott 2-Phase,
3-Phase System,
Wurts Non-Arcing
Lightning Arresters.

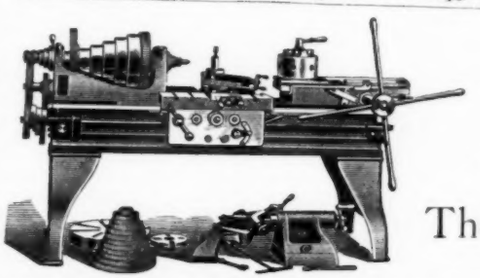
The name of WESTINGHOUSE is a guarantee.

Westinghouse
Electric & Mfg. Co.

Controlled by the Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.

New York, Boston, Chicago, Philadelphia, San Francisco, Buffalo, Syracuse, St. Louis, Atlanta, Tacoma, Mountain Electric Co., Denver. Ahearn & Soper, Ottawa. Westinghouse Electric Co., Ltd., 32 Victoria St., London.





The "SPRINGFIELD"

Engine Lathes, 14, 18 and 24 in.

Accurracy of Lead Screw Guaranteed.
Metric Screw if Desired.
Any Form of Rest or Tailstock.

Crank Shapers, 12, 15 and 20 in.

Removable Box Table.
Extra Strong and Heavy Ram.

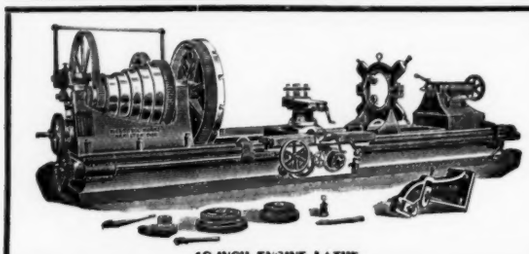
Turret Lathes with many desirable features. Cannot be beaten in design, service or cost.

Also BRASS WORKERS' LATHES, POWER PRESSES, Etc.

Full information given in our book. Write us for it before buying.

Remember, High Grade Tools Only.

The Springfield Machine Tool Company,
Springfield, Ohio, U. S. A.



48-INCH ENGINE LATHE.

ENGINE LATHES ∴ FORGE LATHES
∴ TURRET LATHES ∴
SHAFTING LATHES AXLE LATHES

Modern Machine Tools. .. .. Catalogue Free.

The Niles Tool Works Co.
Hamilton, Ohio, New York, Chicago, Philadelphia, Boston, Pittsburg, St. Louis, 39 Victoria St., London, S. W., England.

The G. A. Gray Co., Cincinnati, Ohio,

call attention to the fact that one of their electrically driven, direct-connected, spiral geared planers (with 4 heads) may be seen in operation in Machinery Hall of the Philadelphia Bourse Exposition. Open daily and Wednesday evenings. Admission free.

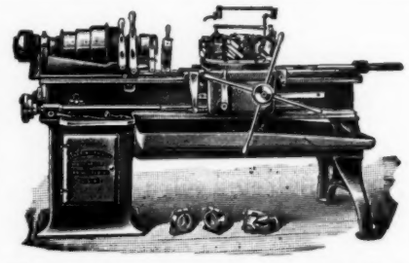
You Know!

that we inaugurated **THE MODERN SYSTEM** of automatically shaping and grinding **LATHE, PLANER** and other **CUTTING TOOLS**, and that we invented the machines to do this work. The average wages cost at our establishment for shaping and grinding all tools upon our **TOOL GRINDING MACHINES** is **LESS THAN 3-4 OF 1 CENT PER TOOL!** Illustrated pamphlet sent on request.

William Sellers & Co. Incorp. **PHILADELPHIA.**

IS not the quantity of work which can be turned off in a given time, using a certain twist drill, of greater importance than the cost of the drill? Our drills are not the lowest priced, can't be, because they are made of the highest grades of stock obtainable; but their EXCEPTIONAL DURABILITY offsets this many times, making them the MOST ECONOMICAL. Let us send you a few for trial.

THE T. & B. TOOL COMPANY,
DANBURY, CONN., U. S. A



The Flat Turret Lathe

Does Lathe work accurately up to 2 in. diameter by 24 in. long.

Jones & Lamson Machine Co.,
Springfield, Vt., U. S. A.

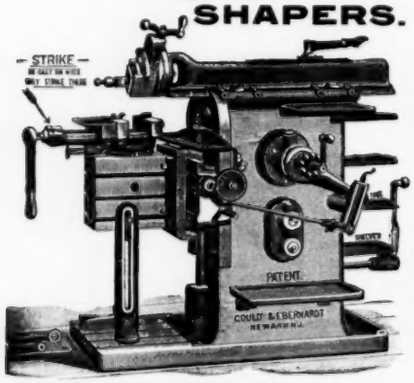
Selling Agent for Germany, Switzerland, Austria-Hungary, Russia, Holland and Belgium: M. KOYEMANN, Charlottenstrasse, 112, Dusseldorf, Germany.
England: HENRY KELLEY & CO., 26 Pall Mall, Manchester.

The Acme Machinery Co.,

CLEVELAND, O.,

Manufacturers of
Acme Bolt and Rivet Headers.
Acme Single, Double and Triple Automatic Bolt Cutters. *Cutting from 1-8 in. to 6 in. Diameter.*
Also Separate Heads and Dies.

Pat. **EXTENSION BASE.**
TRADE MARK.
SHAPERS.



"DOUBLE TRIPLE QUICK" STROKE (Trade Mark).
Gives 100 per cent. more strokes per minute than any other Shaper made. **Write for our Shaper Catalogue.**
GOULD & EBERHARDT, NEWARK, N. J., U. S. A.
Foreign Agents: John Lang & Sons, Johnstone, Scotland. Schuchardt & Schutte, Berlin, Vienna, Brussels. G. Koeppen & Co., Moscow, Russia. Shaper Agents. White, Child & Beney, Vienna, Aus. Shaper Agents.

EXPORT TRADE A SPECIALTY. ST. LOUIS, MO.

SET AND CAP SCREWS
STUDS — **CINCINNATI SCREW & TAP CO.** — NUTS
STANDARD AND SPECIALS.
CINCINNATI, O., U. S. A.
FOR ENGINES AND MACHINERY.

GRANT GEARS

GEAR WHEEL CUTTING.
GRANT GEAR WORKS,
626 Race Street, PHILADELPHIA.
6 Portland Street, BOSTON.
86 Seneca Street, CLEVELAND.
Send for Catalog.

ELECTRIC CRANES.
DYNAMOS and MOTORS.
PAWLING & HARNISCHFEGER,
163 Clinton St., Milwaukee, Wis.
Chicago Office: G. P. NICHOLS & BRO., Managers, 1325 Monadnock Bldg.
THE GILLETTE-HERZOG MANUFACTURING CO.,
Sole Agents Northwestern States. Minneapolis, Minn.

For SUB-PRESSES or LIGHT SPECIAL MACHINERY,
built to order, address
A. F. INESON, Waterbury, Conn.

PLANED BEVEL GEARS
MACHINE MOULDED GEARS.
Gears up to 12 Feet Diameter.

GLEASON TOOL CO.
Mfrs. LATHES and GEAR PLANERS.
6 Race St., Rochester, N. Y.